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Cycling in small suburban communities: A case study of Georgetown, TX

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Cycling in small suburban communities: A case study of Georgetown, TX

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Report

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Dedication

To my parents, grandmother and other family members. Without all the love, understanding, and support, I would not have gone so far in the path of chasing my dream on the other side of the planet.

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Abstract

Cycling in small suburban communities: A case study of Georgetown, TX

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The University of Texas at Austin, 2017

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Small communities have natural advantages in promoting cycling: Smaller geographic scale, major destinations within biking distances, and relatively low volumes of vehicle traffic. Davis, CA and Boulder, CO are known exemplary cycling-friendly communities in the United States. In Texas, however, cycling in small communities remains rare as a transportation means. This study aimed at understanding the driving factors for cycling in Texas suburban communities. The report presents a case study of Georgetown, a suburban city in the Austin Metropolitan Area in Texas. Georgetown is contemplating a Bike Master Plan to address the growing interest in and concerns over cycling in the community. A survey on cycling in Georgetown was conducted in fall 2016, for which this author was a member of the survey team. The survey included two parts, an online version of questionnaire and an onsite version for environmental audits, covering the following main topics: public opinions on cycling, cycling behavioral characteristics, environmental/infrastructure conditions for cycling. The report analyzes survey results and discusses opportunities and challenges facing Georgetown to cycling.

The study findings help inform the Bike Master Plan effort by Georgetown, TX planners. Lessons learned from the Georgetown study are also valuable to the state-wide endeavor to promote cycling, particularly in small communities in Texas.

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Introduction

Cycling rate in the US is remarkably low compared with European countries. The daily trips made by bicycle are less than one percent (Santos, McGuckin, Nakamoto, Gay, & Liss, 2011), while 3%-28% of all trips in seven European countries made by bicycle ("Walking and cycling as transport modes", 2017). Moreover, bicycling showed the most significant increase as a commuting mode of transportation with a increased rate of 60.8% between 2000 and 2012 (McKenzie, B.,2014) Most of the bicycle commuting trips happened in the metropolitan area. Between 2008-2012, some of the largest cities have more than doubled the bike to work rate. For example, Portland, Oregon had the highest bicycle-commuting rate at 6.1 percent increased from 1.8 percent in 2000, and in Minneapolis, the rate increased from 1.9 percent in 2000 to 4.1 percent in 2012.(Bureau, U. C., 2014)

In the past two decades, large cities have been pioneers in leading the growth trend, expanding bike infrastructures, experimenting and implementing different strategies to increase cycling. For instance, New York implemented the bike lanes in bright colors to enhance the visibility, installed bike traffic signals, bike boxes and the most bike lanes since 2000. Portland installed buffered bike lanes, created bike boulevards, experimented with bike corrals, and various bike events. Minneapolis developed a significant off-street bike path network, has the highest per capita bike parking, and also offers accommodations for cycling in cold weather. San Francisco has the most active bike advocacy and bike culture. Chicago is leading the way of bicycle and transit integration with public outreach and enforcement of bicyclist's rights (Pucher and Buehler, 2011), however the City has experienced challenges with high traffic volumes, long trip distances, crowded sidewalks and space, larger geographic, and failures in

connecting with public transit and complimentary reinforcement policy (Pucher, 2012). The turnout was not as expected in some big cities.

Meanwhile, Cycling is rapidly growing in many small cities. According to the 2012 National Household Survey, Small (population 20,000-99,999) and median (population 100,000 to 199,999) size cities in all regions have a greater growth rate than Large (population greater than 200,000). (Mackenzie, 2014) Additionally, many small cities successfully stand out over large cities with a higher bike rate and appeared to be more bike-friendly communities. In American Bike League's 2012 report, cities that has the highest share of bicyclists, 9 of the top 10 cities have a population under 200,000. Portland, Oregon, the exemplary success of cycling in big cities was only ranked 11th, with 6% of bike commuters in 2012. (American Bike League, 2012) In the 2014's American Bike League Report, Portland became the only city with population more than 200,000 population in the top 10 highest share of bicyclist list while the rest are all cities with a population under 200,000. (American Bike League, 2014)

CITY	% OF BIKE COMMUTERS	POPULATION
DAVIS, CA	19.1%	66,009
BOULDER, CO	12.1%	101,812
PALO ALTO, CA	9.5%	66,359
EUGENE, OR	8.7%	157,984
CAMBRIDGE, MA	8.5%	106,456
FORT COLLINS, CO	7.9%	148,634
BERKELEY, CA	7.6%	115,417
SANTA BARBARA, CA	6.9%	89,638
MADISON, WI	6.3%	240,315
MISSOULA, MT	6.2%	68,386

Figure 1. 2012 Top 10 Cities with Highest Share of Bicyclist

CITY	RANK	TOTAL COMMUTE BY BIKE	TOTAL POPULATION
DAVIS, CA	1	23.2%	66,733
BERKELEY, CA	2	9.7%	118,851
BOULDER, CO	3	8.9%	105,101
SOMERVILLE, MA	4	7.4%	78,903
CAMBRIDGE, MA	4	7.4%	109,699
PALO ALTO, CA	5	7.3%	66,968
PORTLAND, OR	6	7.2%	619,445
EUGENE, OR	7	6.8%	160,552
FORT COLLINS, CO	8	6.2%	156,473
SANTA BARBARA, CA	9	6.1%	91,208
MISSOULA, MT	9	6.1%	69,824
BLOOMINGTON, IN	10	5.5%	83,423

Figure 2. 2014 Top 10 Cities with Highest Share of Bicyclist

The National Household Survey divided large cities with median size city at the population 200,000, in Pucher's book "City Cycling ", the small cities defined as cities with population under 300,000. (Pucher & Buehler, 2012) To keep the consistency in comparison and analysis, this article is going to use Pucher's standard of a small city as having a population under 300,000. According to the previous data evidence, it is not hard to see that cycling is rising in small American cities, and small cities are becoming the core of growth in American cycling communities.

There are a number of factors that lend can make small cities ideal environments for bicycle activities such as having smaller geographic scale with relatively calm traffic and destinations within bikeable distance. Additionally, the small-town social atmosphere often allows people to have a closer social relationship with each other and with the local government as well. (Pucher, Buehler, 2012) Some successful cases

showed the evidence, such as in Davis, California. Davis is the first city to become the Platinum awardee and has the highest bike share in the country. (American Bike League, 2014) Davis has a population of 68,111 according to 2016 Census, expanding about 3 miles north from to south, and about 5 miles from east to west, located in the west Central California Valley. (Pucher, Buehler, 2012) The University of California at Davis is the major employer, serves as a primary destination in Davis, and is also the center of where the bicycle culture started. The University established its extensive bike path on campus in 1950's (Pucher, Buehler, 2012), and with this 'seed of cycling', the City of Davis built the first bike lane in the US history in 1967 (City of Davis, 2017) Today, all of the arterial and significant collector streets in Davis have bike lanes, with 76% of the road network covered with bike lanes (American bike league,2016), with over 100 miles of designated bike lanes and paths. (City of Davis,2017) Besides building infrastructure, the City adopted a land use plan and policies that are preventing urban sprawl, which at the same time create a bike-friendly environment. To encourage cycling in the city-sponsored many cycling related programs and events for cycling safety, education and promotion.(Pucher, Buehler,2012)

The City of Boulder, Colorado has had a similar experience in the path of becoming a bicycle-friendly city. Boulder has a population of 97,000, approximately 25 square miles of land within the city limits, is home to the Univeristy of Colorado. The City of Boulder adopted a bike-friendly land use plan and transportation plan. (Pucher, Buehler, 2012) With the natural advantage of more than 300 days of sunshine and nearby mountains (City of Boulder,2017), Boulder became famous for its recreational cycling first, and has successfully increased commuting (Pucher, Buehler, 2012), today with more than 300 miles of dedicated bike paths. Bicycles have become the most popular transportation mode. (City of Boulder, 2017)

Although these successful cases can not be copied, but these cases shares some common elements including having a college campus with a thriving cycling culture, a bike-friendly land use plan, a transportation plan or policy that discourage car use, and bike-promoting programs. With the natural advantages and the right strategy, small cities seems to have much more potential to become a bike-friendly community, however, every small city has its own context and complexity, geographic features, culture, politics, and economy, especially in different region and states.

The City of Georgetown, a suburban city in the Austin Metropolitan Area in Texas, is seeking a Bike Master Plan to meet its growing bicycle demand. What is the drive of cycling in Texas suburban city? What are the differences and similarities between this small city in Texas and other successful cases? This article is focused on the cycling characteristics in the City of Georgetown, Texas, using the bike survey data from the University of Texas Community and Regional Program to find out how cycling thrives in a small suburban city in Texas, what the unique features and factors that encourage cycling are, and what opportunities and challenges in cycling the community is facing.

The study found that the main force of cycling in Georgetown is age group of residents of 55 years of age and older, which represents 49% of the the cyclists in Georgetown. This group mainly bicycle for recreational and personal business at least once a week, among which, cyclists at age of 65 and older are most likely to bike weekly as a routine.

The same group also consider themselves as 'Enthusiastic' riders, and they are more likely to bike on streets than any other groups, and think a bicycle-friendly environment is very important factor for them to consider in choice of location for residency. They prefer to bike during the day when traffic is relatively calm and the road

has a good visibility. In contrast, the 25-34 year old age group represents the major component of "bike to work" cohort, but they are the least likely to bike more frequent than once a week for all purpose of cycling while the 35- 45 age group are more likely to participate in cycling for recreation by using neighborhood street and hike-bike trails. In our sample, males were found to be much more likely to bike than females, and likely to bike more frequently than females. Female participants were much more concerned about cycling in Georgetown than male participants but still had high participation rates compared with other communities.

Location of Georgetown, Texas

Background

Although Georgetown is a small suburban city, considering the cycling trends at the national, regional, and state level is important in understanding the level of cycling in Georgetown. In addition to geographic influences on cycling, understanding the characteristics and context of different types of cycling and different socio-demographic groups are essential processes for analysis in Georgetown.

Cycling to Work in the U.S.

Cycling mode shares is only 0.6% of all transportation modes according to the 2015 Commute Mode Share data (Bureau of Transportation, 2015). However, with the most significant percentage of increase among all commuting modes, the number of people that commute with bikes rose from 488,000 in 2000 to 786,000 in 2012 for a total increase of 60.8 percent. This increase in the number of bicycle commuters exceeded the percentage increase of all other travel modes during that period (McKenzie,2014). Some notable characteristics of bike commuters are that men (0.9%) take more than double the number of commute trips than women (0.3), and commuters with a graduate or professional degree, had the highest rate of bicycle commuting made 0.9% of their trips with those who did not graduate from high school reached 0.7 percent.(Pucher, J., Buehler, R., & Seinen,2011)

Significant increases in cycling prevalence were limited to the well-educated, employed, and 45-64 year olds categories of riders. In contrast, cycling declined significantly among children between the ages of 5 and 15 and among women.(Santos, McGuckin,Nakamoto,Gray, & Liss, 2011)

Looking through the demographic factors in the NHS results, some other national trends are worth consideration:

Geographically, the commuting trip rates by state has a geographic pattern. The states in the west have a relatively high bike commuting rates, an example is Oregon with a rate at 2.3 percent, compared to Washington District of Columbia, which has the highest bicycling to work rate 3.1 percent. The other states are following a pattern that the rate is gradually decreasing from the west to the east and from the north to the south. (Pucher,Buehler, Merom, & Bauman,2011) While the second-highest states are California, Idaho, Montana and Colorado which have the cycling rate at 1.0-1.99 percent, states with the lowest rate under 0.2 percent are mostly southern states: Arkansas, Tennessee, Mississippi, Louisiana and West Virginia. The other states are at the rate between 0.2 percent to 0.99 percent. (Murphy,2014) However, this geographic distribution is based on the accumulative data from 2008-2012, when comparing the result from a different year, the pattern changes.

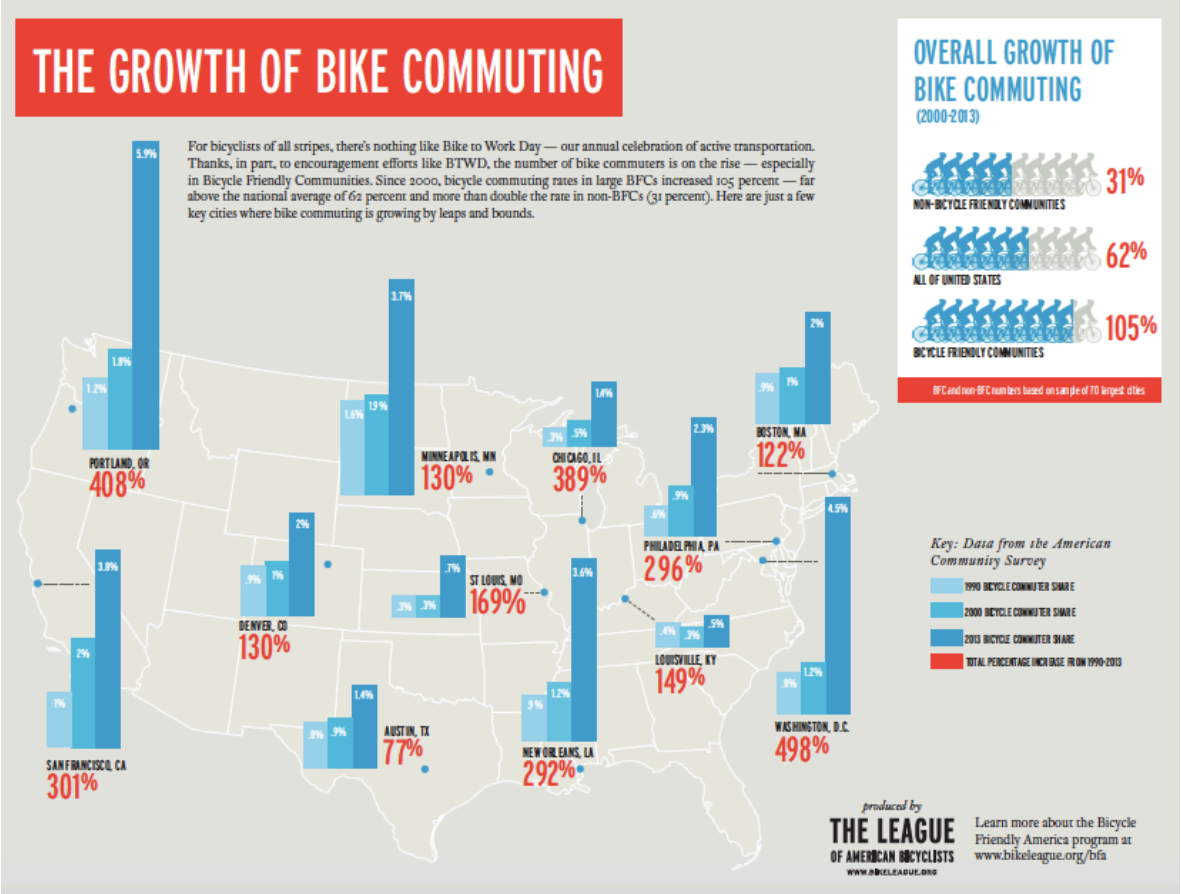

Figure 3. The Growth of Bike Commuting

Data from The League of American Bicyclists indicate that some states have a low rate of commuting, with Louisiana and Tennessee having the lowest bicycle commuting rate at less than 0.2%, become the fastest bicycle commuting growing state with more than 100 percent growth. Same with Massachusetts, Pennsylvania, Virginia and Kentucky, which has a bicycle to work rate lower than 0.8%, are the fasted growing bicycle commuting states. (Szczepanski, 2013) The state data might be able to show the major trends for each state, but different cities could be vary based on the size, location, density, etc. In the same region, large and medium cities have higher rates than small cities. For several regions, relatively low rates of non-motorized travel within

surrounding suburbs contribute to lower overall non-motorized commuting rates for the metropolitan area than for the central city. In the same metropolitan area, the bike to work rate is drawing down from the urban core (1%) through the suburban area (0.4) to the outside the metro area. (Murphy,2014) Even though, numerous smaller communities have higher rates of walking or bicycling than their larger principal city counterpart within the same metropolitan area. For example, Davis, CA, has a bicycle commuting rate of 18.6 percent, but Sacramento, the largest city within the same metropolitan area, has a bicycle commuting rate of 2.5 percent. Among all the high ranking small cities, Davis, CA, and Key West, FL, stand out as having high bicycle commuting rates among places with populations of 20,000 or larger at 18.6 percent and 17.4 percent of all workers, respectively. Most of the top biking cities listed are in the Pacific or Mountain divisions.(Pucher, Buehler, Merom, & Bauman, 2011) This could be due to the geographic characteristics such as topography, weather, and other factors. Many of them are also "college towns," or home to at least one significant college or university. (Pucher, Buehler,2012) Home to at least one large college or university, this is also the case for those small cities with a high bike commuting rate.

Recreational cycling in the U.S.

According to the NHTS, The number of bike trips made for social and recreation purpose increased by 12.8 percent during 2001 to 2019 (from 2,260.51 to 2,546.96). The portion in total recreational trips increased from 2.2 percent in 2001 to 2.4 percent in 2009. What's most intriguing is that bike trips made for social and recreation purpose represented 70.3% of the total bike trips in 2001 and increased by 13% in 2009. But the overall percentage of bicycling for social and recreation trips dropped down to 62% in all bike trips, while the high percentage of increase in "Earn a Living," "Family

/Personal business" and "unreported" responses. (NHTS Datasets .2001, 2009) Notably, recreational cycling is still the dominant purpose of cycling in the US at the national level. There are also some apparent characteristics of recreational cycling that could be identified in the NHTS. Among all of the social and recreational trips, males made trips twice as frequently as females made trips in 2001, with a trend that males made trips almost three times that of females in 2009. Children between ages 5 and 15 made the majority of the recreational bike trips both in 2001 and 2009 but with a significant 9.2 percent drop between 2001 and 2009. People at the age of 40 to 69 contributed more percentage in 2009 than 2001. (Santos, McGuckin,Nakamoto,Gray, & Liss, 2011) Unfortunately, there are limited open data sources on recreational cycling in states and cities level.

Trips to work made by bike only comprised 12 percent of all bike trips nationally (Pucher et al., 2011). Bicycling for recreation (48 percent) is the most common purpose of all bike trips. Personal trips make up a fair share of all trips, including shopping (10 percent), visiting friends (13 percent) and school/church/doctor trips (6 percent) also (Pucher et al., 2011). Because cycling in the city serves additional purposes beyond commuting and recreation, so when cities are considering how to grow their cycling community, they should consider cycling for all types of trip rather than just for commuting to work(Pucher 2011).

Bike Friendly Program

American Bike League announced the newest 2017 Spring Bike Friendly Communities, including one Platinum award, one Gold award, 11 Silver awards and 24 Bronze awards. Among the total 37 awardee communities, the Platinum, the Gold and 29

other awardees are all small communities that have a population under 300,000. (McLeod,2017)

The League of American Bicyclists established a Bike Friendly America program (BFA), based on open data and a state Departments of Transportation survey and state bicycle advocacy organizations. The program recognizes excellence in governmental planning efforts that promote benefits and opportunities of bicycling. (Murphy, 2013) This program also does the ranking for each state based on five categories: Number of bicycle-friendly actions, Infrastructure and funding, Education and encouragement, Legislation and enforcement, Policies and program, Evaluation and planning. BFA also provides the precise information and ranking of bicycle-friendly communities, business, and universities in the state. As of 2017, Washington State ranked first with 416 Bike Friendly Communities being recognized with Platinum (5), Gold(26), Silver (78) and Bronze award (307). Five Platinum awards were given including: Fort Collins, Boulder,Co, Madison, WI, Davis, CA, Portland, OR. Gold awards were given to Breckenridge CO, Corvallis OR, Minneapolis MN, San Luis Obispo CA, Santa Cruz CA, Scottsdale AZ, Steamboat Springs CO, Tempe AZ, Palo Alto CA, Tucson-Eastern Pima County, Wood River Valley ID.(Murphy,2013))

Among all Platinum and the Gold awardees of the BFA program, many small cities are standing out. For instance, the Platinum-awarded Davis, CA, which also has the highest bike to work rate (18.6) among the cities has a population between 20,000 and 99,999. Boulder Colorado has bike to work rate of 10.5 percent, and for gold awardees, many cities have a population around or under 100,000. Such as Corvallis, OR, Palo

Alto, CA, Bloomington, IN and more and more small cities moved to the Bike Friendly approach each year. (Award data base of League of American Bicyclists, 2017)

Cycling in Texas

Texas devoted $144,337,876 to the bicycle between 2012 and 2014, established 1200 natural surface bike trails, and has 925 roads open to the cyclist. Approximately 0.3% of commuters use biking as a transportation mode. The fatality rate between 2011-2013 is 10 persons per 10,000 bicycling commuters, higher than the average in all places. Texas has a ranking of #25 and has a relative low level in many cycling aspects compared with other states in the same tier, but Texas has ten bike-friendly communities including one Gold community, the City of Austin. The ten bike-friendly communities include five suburban communities, three urban communities, and one county.

According to the evaluation results from the American Bike League, Texas has a better ranking than in the federal data thanks to it's higher ranking in Education & Encouragement (11) and Evaluation & Planning (7) among the 50 states (American Bike league, report card), although Texas has a relatively low ranking and has much more need to be done in cycling, it has been putting the effort into assessing the existing facilities, planning for more, and encouraging people to participate in more cycling in Texas. However, there are things that have not been implemented such as a Safe Passing Law (3 ft+), a Statewide bike plan last 10 years and 2% or more fed funds on bike/ped. The lowest ranking shows in the Infrastructure & Funding, especially in the Design and Existence of Infrastructure, State Transportation Funding and the use of the federal

transportation funding. In another word, there are numerous barriers and a long process ahead in the efforts toward building a complete bicycle infrastructure and the current funding that designated towards bicycling is still at a very low level. In the Complete Street, Design, and Access Policy categories, there's still space for bicycle and pedestrian oriented policy and implementations. The bike mode share is still in need of improvement in Texas. As mentioned earlier, the bicycle-oriented policy component needs to be addressed, including laws that create protection for cyclists, laws that restrict cyclists and laws that influence the built environment. Also, the education requirement for drivers is necessary for promoting awareness and respect of cyclists and pedestrian who also share the right of way.

Cycling Investment in Texas Compared with other states

Whether evaluating the national level bicycling trends or the bike-friendly communities, the southern states have the lowest bicycling rate and lowest number of bike-friendly cities compared with the west and east. In the Southern states, Arizona, Texas, Georgia, Florida and North Carolina are those that have the higher ranking between #11-25 (of the 50 states) based on the Bike Friendly America state ranking. Take three of those coastal states and compare with the western coastal state California (state ranking #3), the result probably could explain some reasons.

California is the only state with a dedicated bike-pedestrian projects state budget that has been increasing from 2000 to 2014 and has effectively doubled. Florida reached their highest funding between 2009-2011 then dropped almost one third between 2012-

2014. Texas' bike and pedestrian fund doubled between 2009-2012, while Arizona stayed relatively low in all time frames.

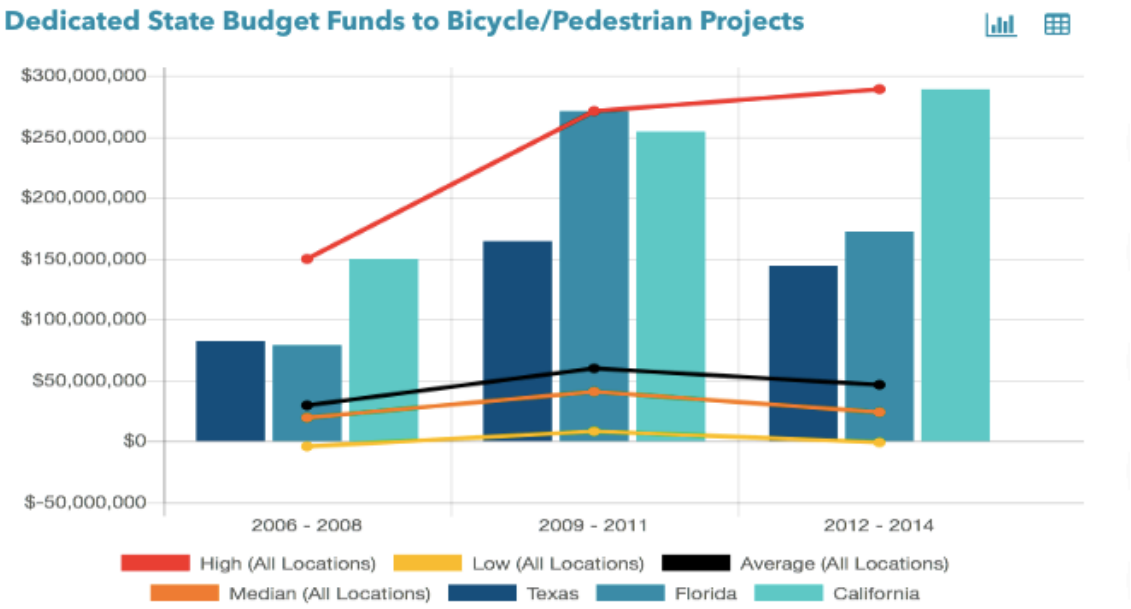

Figure 4. Dedicated State Budget Funds to Bicycle/ pedestrian Project

Source:Benchmarking / Bicycle Friendly States Survey 2015, FHWA FMIS 2006–2014 (annual data); ACS 2008, 3-yr est; ACS 2011, 3-yr est; ACS 2013, 3-yr est.

But what's interesting is that while California has the highest dedicated fund, its Transportation Department has zero equivalent full-time staff designated on bike and pedestrian related work while Florida has the most with a designated staff of 66.

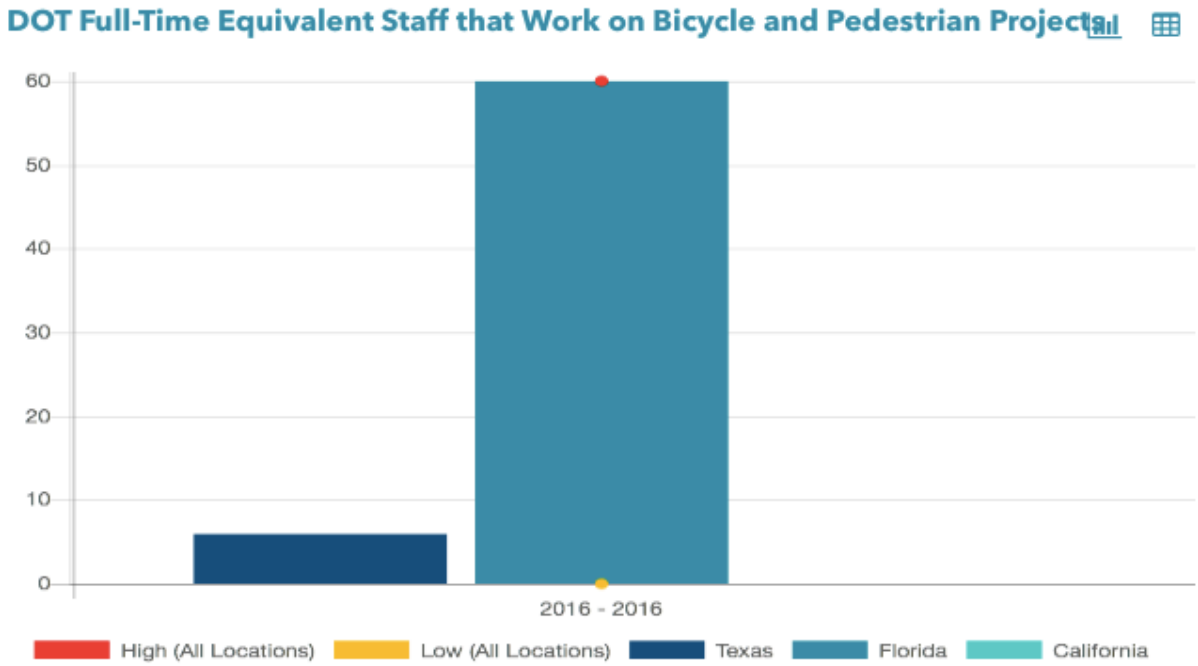

Figure 5. DOT full-Time Equivalent Staff that Work on Bicycle and Pedestrian Project Source: Benchmarking / Bicycle Friendly States Survey 2015, Advocacy Advance, 2014 ("State Revenue Sources"), ACS 2013 3-yr est.

Looking at infrastructure, California and Florida have almost the same mileage of bike trails and lanes, Arizona follows in second place, and Texas has the least. Safety is one of the best factors for measuring the infrastructure, with fatality rates (Bicyclist Fatalities per 10k Bicycling Commuters) being the primary indicators of safety. Among the four chosen states, Florida has the highest fatality rates overall. Although a significant drop showed in 2008-2012 compared with 2005-2007, the overall rates are still higher than the median and the average level of all locations. The second highest fatality rate was reported in Texas, much lower than Florida, but still over the median and average level. California has the lowest fatality rate, which is always under 10 per 10k bicycling commuters threshold. One of the best advantages of being bike friendly place is public

health; the health indicators could help us to understand necessity and impact of cycling on public health. First, Obesity. The data measured the percentage of adults who are obese. Texas overran the other three states; it has the most obese adults with a significantly higher percentage every year from 2009-2013. Second, Diabetes. The overall average trend is increasing in all four states, and Florida has the highest diabetes rate through all time. Third. Asthma. All four states tend to have a flat changing rate of asthma, Florida had a 1.9% decrease. Fourth, High blood pressure. All states had slightly increased rate while Florida and Texas have the highest one.

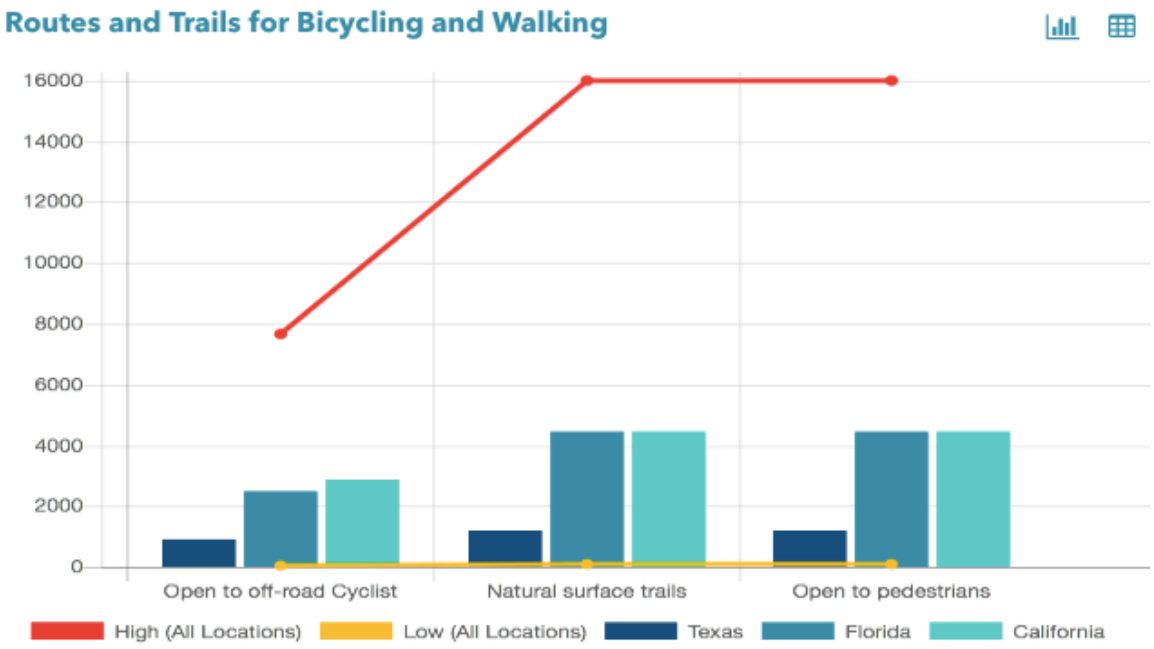

Figure 6. Routes and Trails for Bicycling and Walking

Source:Benchmarking / Bicycle Friendly States Survey 2015; Rail To Trails Conservancy

When looking at the Bike Share in the commuters, Texas and Florida has the rate that lower than the national level, until 2013, Florida reached the 0.6% bike share in all commuters. Although Texas has the lowest rate in all time period, the rate increased 0.1% between 2011-2013.

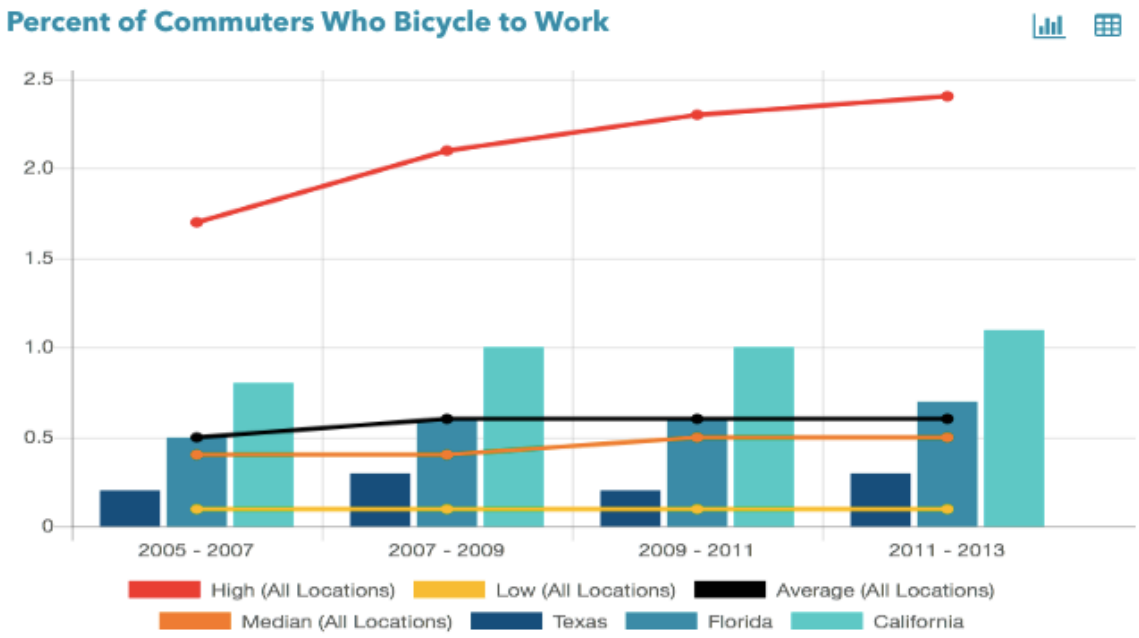

Figure 7. Percent of Commuters who Bicycle to Work

Source: Benchmarking / ACS 3-year est.

All the evidence of cycling is in accordance with the fact that Texas is a highly car-dependent state. This result could be due to its geographical sprawl pattern, the intensive highway system, long high-heat weather and the relatively low gas cost. In many aspects, Texas was not close to the bike-friendly state, but efforts have been made to encouraging cycling in Texas. The Texas Department of Transportation developed

guidelines and programs to lead and encourage cities to promote cycling. For example, the Strategic Direction Report: Opportunities for TxDOT's Bicycle Program is developed to guide municipalities from expanding bike network to training, education etc. (Texas Department of Transportation,2015) Many cities are also putting efforts into increasing cycling, especially such fast-growing cities as San Antonio, Dallas, Houston, and Austin. They established their bike master plan and had been implementing strategies to encourage cycling. By spring 2017, there are 10 Bike Friendly Communities recognized by the League of American Bicyclists, and the City of Austin is recognized with the Gold award. (League of American Bicyclists, 2017)

Among all the studies on cycling, most of the attention is focused on nationwide data (Pucher, 1999, McKenzie,2014, Kuzmyak, & Dill, 2012, and Santos, 2011) or large cities like Portland or St Louis (Dill, J., & Voros, K. 2007, Boettge, Hall & Crawford, 2017). Although scholars did an extensive study based on data from these places, some of them may not apply to other places since the context is different in small cities. Some of the studies took the small cities as cases but tend to concentrate on the successful cycling cases like Davis, California and Boulder, Colorado (Pucher & Buehler,2012). Besides, almost all the study has been focused on the cycling as commute mode rather than recreational, even the more than 60% percent of the bike trips in the US is for recreational purposes (Makenzie,2014). This is due to the benefits of the bike as a commuter,which reduces the traffic pressure, is much more environmentally friendly, has a wide range affordability for all groups of people, and accelerates the public health level. But in daily life, when people use bikes, the boundary of trip purpose is not usually as

clear, people may stop for errands on their way to work, and meet friends or bike through a park on their way home. The purposes are permeated with each other, and may also affect each other.

Literature review

Factors Affecting Cycling

Many studies examined the factors that affect cycling in the US, characterized cycling through sociodemographic factors, identified the correlations between the built environment and evaluated other objective factors that may encourage or discourage cycling.

The earlier approach of factors affecting cycling is the Pucher and Komanoff's study, based on the Nationwide Personal Transportation Survey data. The study analyzed the bicycle mode share and found out over half of the bicycle trips are for social and recreational purposes, cycling rates fall sharply with increasing age, and the cyclists, as a group in the US, is concentrated among children, young men, and inversely correlated with income. (Pucher, Komanoff & Schimek, 1999) Besides, the study also examined factors that affect cycling levels by comparing six American and one Canadian bike-friendly city. The study found several factors affecting cycling nationwide.

Public attitude and culture. The fundamental and major form of local transportation considered normal for a culture, will affect the use of cycling. For example, even if the majority of people own a bike in the US, but the major transportation mode still dominated by car, cycling is will not be considered mainstream for the culture.

Public images. Public image mainly considers the perception of the different type of cycling and the cyclists behavior. The recreational cycling has an enthusiastic image while the commuting could be intimidating because of the built environment, thus discourage people cycling.

Size of the city and the density. When city development is sprawling and wide spread, people are less likely to cycle. This can include the distance of the city expanding and the distance between the places in the city. But the size is not alway absolute inverse with the cycling trend, In the Mckenzie's report based on the 2008-2012 ACS, the study confirmed that in smaller size cities where the destinations are in bikeable distance and the traffic is relatively light, will increase the attractiveness of nonmotorized travel mode. But in large cities where public transit is much more accessible, will encourage cycling as a supplement travel mode to the public transit.(Mckenzie, 2014)

Cost of driving and public transportation. This factor not only includes the price of gas, road tolls taxes and other expense of the travel by car by also the opportunity and accessibility of public transit that can save the travel cost and reduce the car dependence, which will encourage an alternative transportation mode cycling or walking.

Income. The wealthier the household is, the more likely they own cars. But this does not necessarily mean the higher income, the lower bike utility, since many European countries are the most wealthiest country in the world and still have high bike mode share. (Schimek & Komanoff, 1999) In addition, this study was conducted in 1999, which may be outdated, because from the 2008-2012 American Community Survey, the $100,000 and higher households has an increase in cycling activity. (McKenzie, 2014)

Climate. Case studies showed that climate has an obvious influence on cycling on the US. The rain and the summer heat in the south discourages cycling. The author also pointed out that in European countries, for example northern Europe where has not as good weather as southern Europe, has a higher bike mode share. Another study provided a more accurate finding on weather in that even the weather condition affects

the cycling, but only an extreme weather event will cause an obvious change in cycling.(Kuzmyak & Dill, 2012)

Perception of danger. Cycling accidents are a the major concern of safety, which is related to the right of cyclists on the road. Based on varying cycling infrastructure design, the awareness of the cyclists' existence, and knowledge of law and regulations for both cyclists and motorists, vary from community to community.

Cycling infrastructure. Surprisingly, the study found cycling infrastructure the factor that would increase cycling the most. (Pucher, Komanoff & Schimek, 1999)

The Pucher and Komanoff''s study has covered both sociodemographic factors and environment factors. Although the study did not covered all factor that might be related and some results may be outdated, this study still built a primary spectrum for better understanding the factors that affect cycling. Many later studies filled the gaps and discussed some other factors. Sociodemographic factors and built environment factors are the most popular factors that were discussed. In many studies, sociodemographic factors was treated as the characteristics instead of factors since they were not objective factors that could be changed. By evaluating the relationship between the sociodemographic factors, we can more clearly understand the user and potential user better, and use this strategy to specifically meet the demand. In this perspective, sociodemographic factors could make a difference at least in the future bicycle planning process.

Santos' study did an extensive analysis of the relationships between cycling and **sociodemographic factors**, population density, and transportation bicycling using the data set of the National Household Survey. The study analyzed the number of trips reported through socio demographic subgroups, **Gender, Age, Ethnicity, Nationality, Education, Employment Status and Household Income**. The study found that trips made by males are significantly more than trips made by females

(Nehme, Pérez, Ranjit, Amick & Kohl, 2016), which is consistent with other studies showing that males are much more likely to cycle than females. (Santos, McGuckin, Nakamoto, Gray & Liss, 2011) Race, ethnicity and education also appears to be significantly relevant in cases where bicycling is chosen primarily for transportation purposes. For example, a study showed people with a graduate degree are three times more likely to bike than those with only a high school degree. Age is more significant for females than males in all age groups except in the 16-24year old age group, in all-purpose cycling. Research showed black males are more likely to cycle than white males and any other ethnicity male, which represents a different perspective with other studies indicated only indicated that White and Male are much more likely to bike than other groups. (Mckenzie, 2014) Females with less than high school degrees are not relevant with cycling, while female children and females with college degrees are much more likely to cycle than their male cohort. Population density is significantly relevant for transportation cycling. (Nehme, Pérez, Ranjit, Amick & Kohl, 2016) The study also compared the correlation for different trip purpose which, is also the only study that considered recreational cycling differently with other trip purpose. For people under the age of 25, bike to activities and school were the most reported. The 16 to 24 year old age group and 25 to 44 age group have almost the same amount for transportation, but the 16 to 24 year old age group are mostly cycling for social or other activities, while the 25 to 44 year olds cycled for work. The gender difference is also significantly different in cycling for work trips. (Nehme, Pérez,Ranjit, Amick, & Kohl, 2016)

Another popular factors that has been studied by many is built environment. One study analyzed the correlations of built environment factors and respondents' choice of cycling. The study noticed several built environment factors significantly influence an individual's choice to cycling.

Distance to the trail has a positive effect on cycling, so as the "presence of combined trails and bike lanes in the neighborhood." The study also showed that installing **bike infrastructure** will increase the likelihood of cycling (Moudon, Lee, Cheadle, Collier, Johnson, Schmid, & Weather, 2005). This result is very different from the previously mentioned studies where bike infrastructure was show to be developed as a response to the demand (Pucher, Komanoff, & Schimek, 1999). Moundon and others' study used the result of perception questions from the survey that the respondents think adding trail or bike lanes would increase them cycling more, and the in Pucher and others' stated the result of before and after study, which is much more convincing statistically, of course, the before and after study would also have its challenge that the survey conductor may not be able to get answer from the same respondents before and after. Another study measured the factors that affect the propensities of switching from motor vehicle to bicycle and pedestrian facility conducted a before-and-after study in Chicago. And this study dealt with the challenge by asking interviewee who did not have a previous experience on the project site , asking interviewee when they started to use the particular facility and provide them option to indicate that they did not make the same purpose of trip before the facility was installed.And this study also found that the installation of the bike and pedestrian facility is significant in encouraging previously Single Occupancy Vehicle user to bicyclists (Thakuriah, Metaxatos, Lin, & Jensen, 2012), which is a great evidence that bike infrastructure affecting the cycling. However, one thing is worth to notice is that these two studies mentioned above are in different context, King County, Washington vs. Suburban Chicago, the different local context may alter the result.

The Moudon and others' study also indicates that the catchment areas of convenience stores, offices buildings, fast-food restaurants, hospitals, and multifamily

residential provide good environment for cycling. (Moudon, Lee, Cheadle, Collier, Johnson, Schmid, & Weather, 2005) This refers to the **land use** factors, A compact, mixed-use settings will encourage both walking and cycling , especially for utilitarian purposes. Households located in a in mixed-use areas has a lower vehicles ownership and much more likely to make trips to destinations that in walking and biking distance, and are more likely to use transit for long distance trips outside the community. (Kuzmyak & Dill, 2012) Another study also noticed that under commercial use, higher neighborhood commercial has a positive affect on the likelihood of cycling but negative impact from the large retail like shopping mall. (Winters, Brauer, Setton & Teschke, 2010)

Studies also found that the **road network** related factors, **higher intersection density**, **connectivity** (Winters, Brauer, Setton & Teschke, 2010), **population density** were associated with a greater likelihood of cycling. (Kerr, Emond, Badland, Reis, Sarmiento, Carlson, Dyck, 2016) Also some other **perception factors** of the built environment such as neighborhood traffic problems and automobile-oriented facilities, are shown as moderately significant to cycling. (Moudon, Lee, Cheadle, Collier, Johnson, Schmid, & Weather, 2005) Finally, issues such as perceived aesthetics, perceived traffic and crime safety also had somewhat of an influence on an individual's choice to cycle. (Kerr, Emond, Badland, Reis, Sarmiento, Carlson, Dyck, 2016)

METHODS USED IN EXISTING STUDIES

Many existing studies chose a place or project to examine cycling within the context of the characteristics observed. One featured study method is comparing the before and after conditions for installation of the cycling facility. For example, one study

conducted based on a bicycle and pedestrian facility used the location-based survey data at the CMAQ founded facility sites and measured the correlations of use patterns of current facilities, site-level attributes, and the choice of the travel mode. The study result found a significant statistical association exists between the path and the outcome of switching from being an exclusive SOV user. Large portions of cyclists using pedestrian facilities tended to report having exclusively used a car previous to use the facility etc. The study found that the site level factors, which indicate installation of the bike and pedestrian facilities, played an important role in the propensity of switching from SOV use for the current trip purpose(Metaxatos & Jensen, 2012). Moreover, the increase of the non-motorized use does not necessarily result from the switch of the SOV user. This is an very important perspective that needed to be considered in the US context since the majority of the bicycle trips are recreational instead of a transportation mode. The study also found that: Sites with a lower percentage of zero-car households, a more significant share of low-income and minority households, and lower crime rates attracted exclusive car users to a greater extent. And neighborhood with relatively low car-ownership levels and mixed population demographics may especially merit consideration as potentially meeting the goal of the CMAQ program. (Metaxatos & Jensen, 2012)

Some studies concentrated on user-based assessment of the existing bike facilities. Level of Traffic Stress, which based on the level of the stress the street segment put on the cyclists as result of the environmental characteristics, is a widely used method.(Boettge,Hall,& Crawford,2017) Another user characteristics based assessment is Bicycle Route Choice studies. This method is used to analyzing the route choice of cyclists and examine the characteristics of cyclists. Because BRC studies combines the preference with the built environment, it could also be a tool for bike network assessment. The data are location-based and user-based, so results accurately reflect the

differences between each location. Those methods used the result of the level of stress data by asking the perception questions to the user, and combine with the street segment to assess the existing infrastructure.

Survey is a fundamental tool in collecting data for all studies. Some conduct survey through phone interview to examine the relationships between levels of cycling and socio-demographic factors, environmental factors, perceptions of cyclists toward the environment, and attitudes. (Dill, 2007) However, this method is challenging on the data accuracy, especially for the environmental factors, the interviewee may have unclear memory of the cycling experience when interviewed. Also, if the data is entirely dependent on the survey result which is experience, perception, and memory other than physical audit, the result may be biased. One of the most commonly utilized methods is the online survey, examine the demographic and residence information, attitudes towards bicycling motivators, bicycling barriers, walking motivators from the survey. (Rybarczyk, 2014) The online survey is probably the most efficient way to survey a certain time frame and a very objective way compared with an interview, which involves secondhand input error, and typically will get a relatively high rate of responses that lead to a high confidence of the sample data. However, the survey has its constraint as well, the designer of the survey normally do not have same experience and survey may have constraints, for example, people may find their experience or preference, not in the listed answer. Face to face could compensate this point. A pre and post-project study interviewed people on site of the facility and identified if the interviewee was cycling in the same area before, and used the interview survey result to find the changes of people's behavior, further examine the factors affecting the propensity of using the bike and pedestrian facilities. The on-site interview avoided the flaws in the online survey, but there is still a barrier to this method. There were 220 Bike and Pedestrian facility in the

city and sample were three bike facilities and five pedestrian facilities in the city, which may not be significantly representative, this may occur due to the limited number of the interviewer with highly engaged conversation.

Learning from the previous studies, a method that combined the online survey with on-site intercept survey, environment audit with subjective perception from participants could lead to a better understanding of cycling behavior and environment. Also looking through the performance of factors that affect cycling in national level and other places in the study area could provide a better picture of the local cycling characteristics. The combination of questions and geographic location will combine the intangible user characteristics with the visible infrastructures and the built environment. Those information are valuable experience in directing this article to tailor a more complete, efficient and appropriate study method based on the study area's context. First, the study area has existing bicycle facilities, which requires user-based assessment methods, and location based site environment analysis. Second, although the city of Georgetown does not have a complete cycling network, but cyclists have been choosing bikeable space like shoulder and road to bike in the city, it is important to understand how they choose the route and which routes the cyclists prefer. Third, the study will only gather the information in the city wide at once , it is important to include a wide range of information related to cycling.

Method

SURVEY

Community Regional Planning students from the University of Texas at Austin conducted a survey for the city of Georgetown to better understand the cycling context. The whole process of study includes research, online and on-site data collection, data analysis, and three meetings with city officials.

After the first meeting with the city officials, and studied some general information of Georgetown, we had an understanding of the need for Georgetown and the barriers from the city officials perspective. To have a better understanding of the people's opinion, the existing facilities and other information of cycling in Georgetown, we decide to use online survey, intercept survey and on-site environmental audit, which could supplement the disadvantage of each method also enriching each other at the same time. This multi-approach even considered about the different ranges of literacy and the accessibility of electronic devices.

Online survey and implementation

The online survey is designed based on seven components: Demographic information, Household information, Type of Cyclist, Cycling trip information, Bike infrastructure preference, Bike infrastructure satisfaction, Level of comfort and Safety. The Online survey has 26 questions, with both single and multiple choices, takes approximately 8-10 minutes. We took some other cycling related surveys as our examples during the survey design process, such as the Heart Foundation Women and Cycling 2013 Survey, the Thanet Cycling Questionnaire and the 2013 Australian Cycling Participation Survey. We tried several strategies to get a better survey result. We put the

sensitive personal social-demographic questions at the very end to ensure people will answer all the other "comfortable" questions first. Because not everyone has biked in Georgetown, we asked about "have you biked in Georgetown?" to have an idea of the percentage of cyclists and find out the barriers and concerns that stopping people biking in Georgetown. Considering the Hispanics or Latinos is 18.07%(census, 2016) percent of the whole population, we provided the survey both in English and Spanish.

The online survey was sent out to the City's citizen engagement platform, Next Door. Other than the official engagement platform, we also developed a contact list of the local stakeholders, the homeowner association, the non-profit organizations, School district, PTAs, local cycling club, community association, tourist center, local business, and the universities. We used email as our public outreach method to spread out our online survey. The online survey was live from October 25, 2016, to November 16th, 2016. We received 682 survey responses from the online survey.

Intercept Survey and Implementation

The intercept survey was designed to enrich the survey result, different from the online survey. The intercept survey is a simple version of the online survey. We took off most of the social-demographic questions, this is considering the instance of intercepting people on the street and the comfort of being asked questions by strangers(our interviewers). The intercept survey was also designed in two versions, "cyclist" and "non-cyclist" questionnaires, the two versions have different concentrations, for cyclists, the questions are more concentrate on their experience, while the "Non-cyclist " is concentrate on what's stopping them from cycling and their concerns. The interviewer will determine which questionnaire based on the answer from the first question "Are you a cyclist?".

We surveyed 232 of people at 23 locations spread across Georgetown. The locations included: downtown, a retirement community, a strip mall, a high school, various spots along the hike and bike trail, the library, grocery stores, a garage sale, and various other spots around the city. Locations were selected throughout the city as a way to ensure diverse capture of respondents. The surveying took place from 9 am to 6 pm on a Friday, 9 am to 3 pm on a Saturday, and 3pm to 6 pm on a Thursday. Locations were explicitly picked to capture people at different times on weekday and weekend to get a diversity of people across the city. Two interviewers as a team assigned three designated locations in town

Environment Audit

The locations we picked for intercept survey are evenly distributed in all neighborhoods in Georgetown, and they are all in the public area that connected with streets and roads. We designed an environmental audit for the nearest crosswalk around our survey location to assess the existing cycling facility usage, the built environment, and the roadway condition to understand better the existing environment and the potential to accommodate a bike lane. The audits factors including surrounding environment, type of land use, street elements etc. Each group of interviewers will conduct one environment audit for each location the intercept survey happened.

Survey data analysis

Cross-tabulation

By using the data result from our class project, I did the cross tabulation analyze on Gender, Age, Income, and race, to look at the difference between each cohort

including cycling behavior, preference, purpose, preferred cycling times, travel distance, etc. The goal is to find the uniqueness of Georgetown Cycling.

After looking at the survey result, and noticed the characteristics of cycling in Georgetown, a second round further cross tabulation that concentrated on the factors that make Georgetown unique, mainly looking at the differences of other variables when keeping some of the factors as the dummy variable. Inspired by the methods that measure the user experience, I chose three type of questions to further examine the characteristics of the factors in Georgetown that has a different result with the national level and other places. The analysis will focus on the characteristics summarized form the first round cross tabulation analysis on

Graphics

After collected the survey data from online, intercept and the environment audit, we coded the online survey data and the intercept survey data in binary format whenever possible and other cases, subjective responses were cleared and retained. We used simple graphics to closely understand the profile and behavior characteristic of our Sample group.

Comparative study

Since we get the basic profile of Cyclists, by comparing the result of Georgetown with national, state level and other cities figure, we could tell what can be approved in Georgetown and what's the challenges out there. These include comparing the factors that affecting cycling and characteristics of cycling in different levels and places.

Results

Survey Results

By the time we closed our online survey, we received a total of 914 survey responses including 682 survey responses from online and 232 from the intercept survey along with 24 environment audits. With the population size of Georgetown, Texas being 67,140, the sample size that could provide a 99% confidence level with 5% margin of error is 660; in this case, our sample size of 914 is far more than this and could help us to lower the margin of error.

Survey Sample Profile

To efficiently represent cycling in the city, we need to survey the public to closely represent the social, economic, and demographic profile of the City of Georgetown. After a partial analysis of 760 survey responses, we compared the social, economic, and demographic data with the general profile of the city presented in our initial Georgetown study. This review would help us determine how representative our survey sample group is of Georgetown. There are seven characteristics selected for this comparison: Household Size, Age, Gender, Commuting Patterns, Race/Ethnicity, Household Income, and Education Level.

For our review, we started with four categories that suggest the representation of the sample group starting with Household size. Georgetown has an average household size of 2.5 persons and a median age of 44.8 years. As we can see in figure 1 and figure 2, our analysis of the sample group results shows consistency with the city profile. Our survey sample group shows a majority of 57.3% two-person households with significant percentages of 12.4% and 13.7% at three- and four-person categories respectively, which

shows a relation to our initial finding. Our analysis also indicates a significant number of responses (32.2%) in the age cohort of 35 to 54 and adequate representation of senior categories (55 to 64 and 65+), but so far, we still have a shortage of teenagers and young adult respondents.

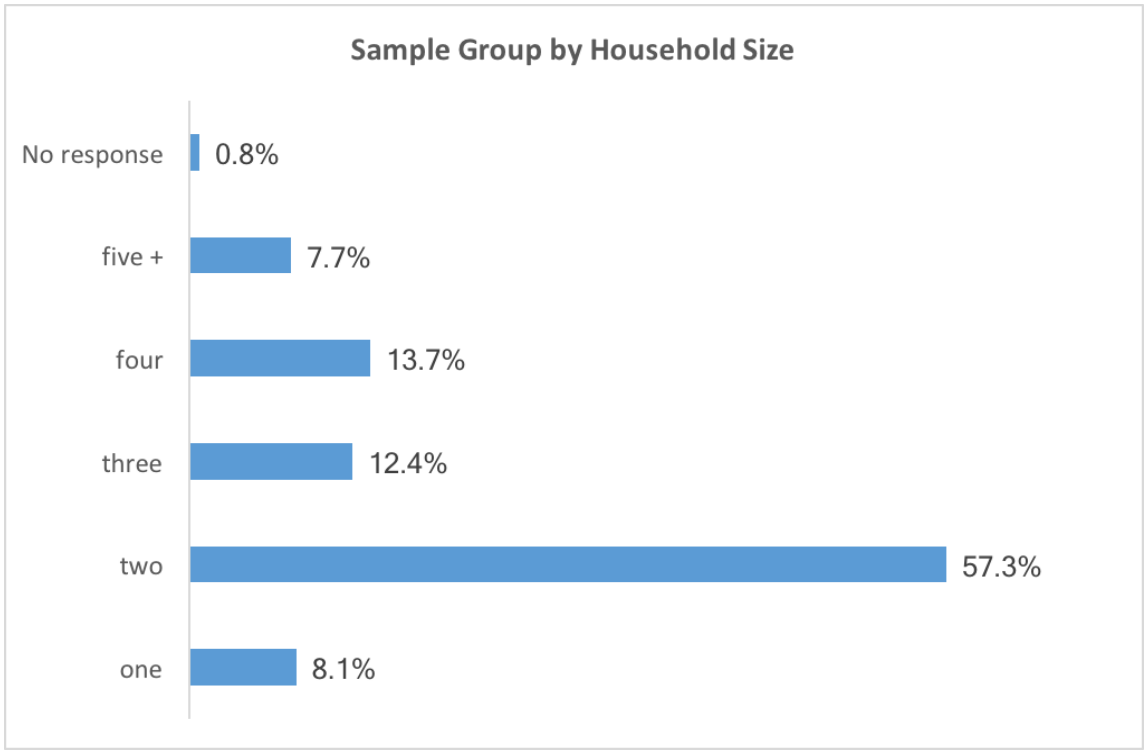

Figure 8. Sample Group by Household Size

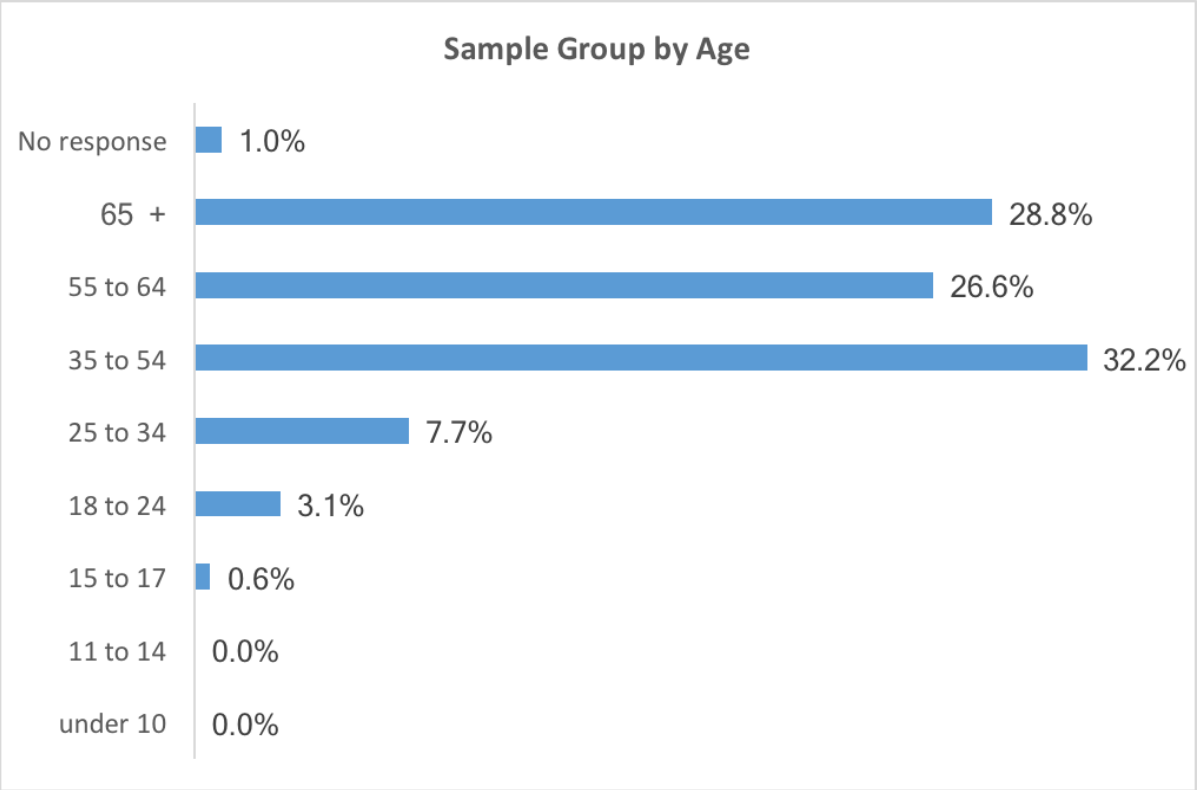

Figure 9. Sample Group by Age

The next two characteristics of our sample group review suggest a representation of the city profile at a more moderate level. According to our initial study of Georgetown, the gender split of the city is Male 47.8% and Female 52.2%, The sample group analysis shows a split of Male 51.3% and Female 46.3% as shown in figure 3. Based on this percentage, our results may, unfortunately, skew more male than reality. We tried to control for this in the analysis, however, by separating out responses by gender.

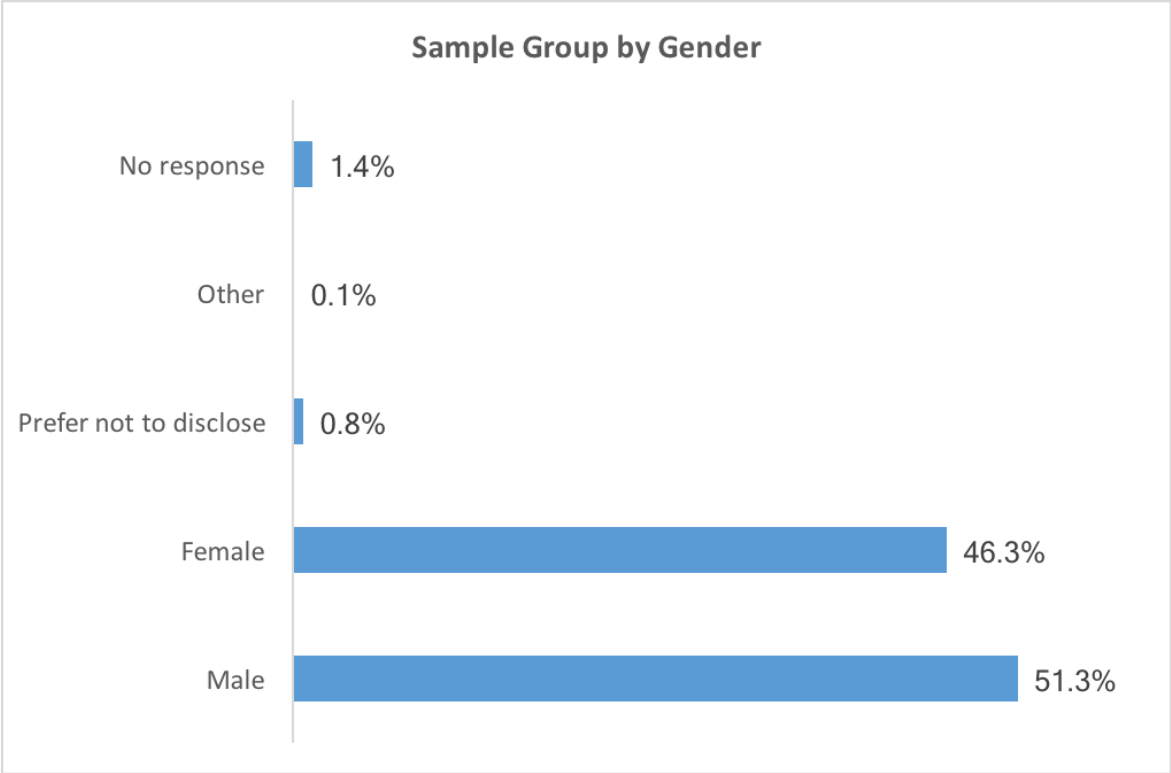

Figure 10. Sample Group by Gender

We also looked at the ethnicity breakdown of the sample, compared with the ethnicity profile of the city. he percentage of our sample has 9% more White people and 2.5% less Black or African American people and 13% less Hispanic or Latino people than the city. This means the latter groups are underrepresented in our sample, which we should consider during the analyzing process.

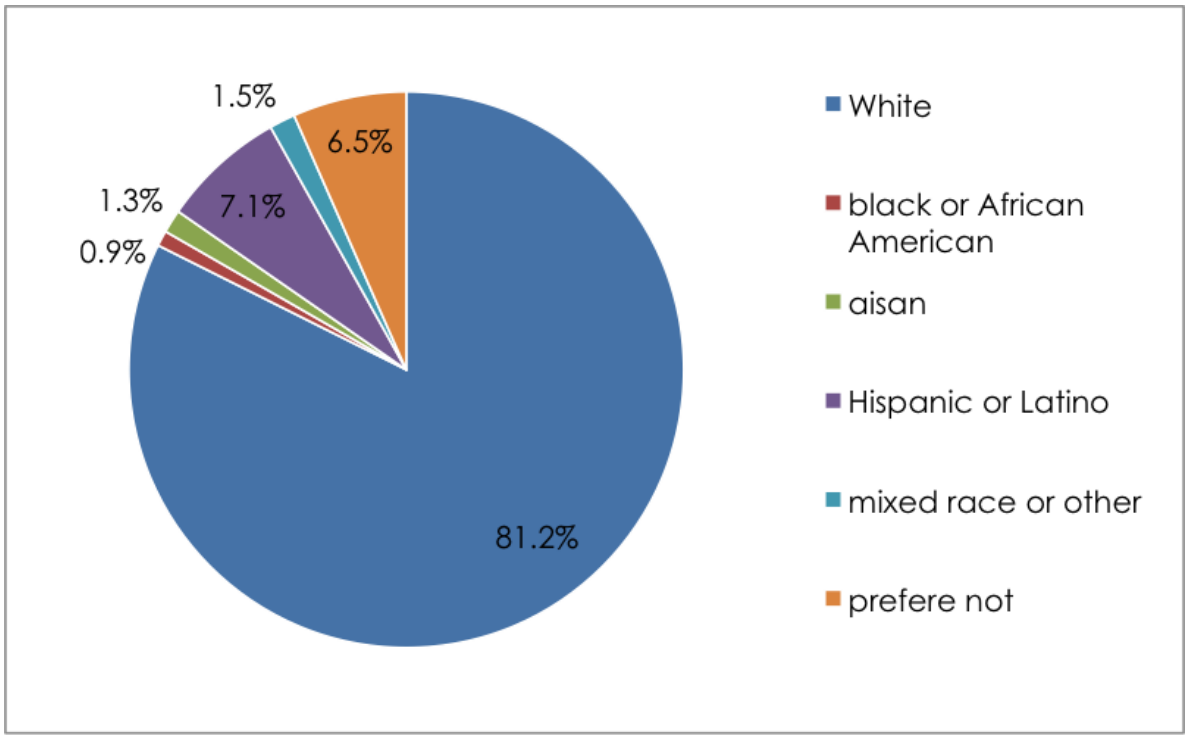

Figure 11. Sample Group by Ethnicity

Characteristics across Socio-Demographic Factors

Because our intercept survey and the online survey had a different approach regarding questions in order to be clear and accurate, this study only used the 674 responses from the online survey. In our sample group, 90 percent of participants are residents of Georgetown and 10 percent people are non-residents ofthe city of Georgetown. 32 percent of people work in Georgetown while 68 percent of them work out of town. Among those 32 percent of people who work in Georgetown, 90 percent of them live and work in the city; this group is 28 percent of our total survey sample.

77 percent of our respondents have ever biked in Georgetown. 11.1 percent of total responses showed they bike to work, and this number is 36 percent of all participants who work in Georgetown and 14.5 percent of all people who have biked in Georgetown. Although this number cannot be used as mode share, it still gave us an idea of the weight of biking as a form of commuting in Georgetown; a significant amount of cyclists are using the bike as a commuting mode. The number of those who bike to work doesn't necessary mean the rest of the people use biking for non-recreational use. Rather, this number could only be higher since the bike purpose question is a multiple-answer based on specific social and recreational activities; thisimplies that the commuters could be the non-work user as well. Among all the bike purpose responses, people use the bike for the social-recreational purpose much more than use it to commute to work in Georgetown; 63.9% of our participants bike for recreational and exercise uses at least weekly. This result is also consistent with the national trend that more than half of bike trips are for social and recreational purposes.

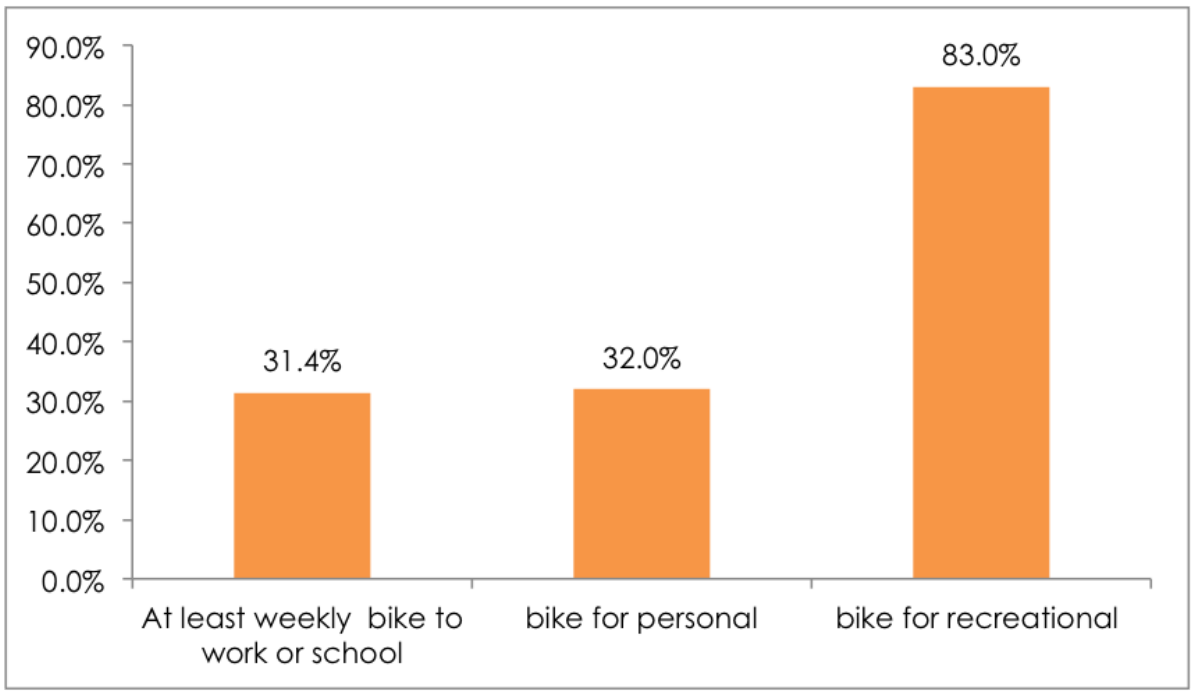

Figure 12. Trips made at least once a week

Among all the people who have ever biked in Georgetown, 44% are female, and 54% are male (2% chose not to disclose). Respondents who bike to work were 39% women and 59% men. In Georgetown, women have a higher participation in cycling compared with the national level mentioned earlier in the background. The 2009 all-purpose trips made by women nationally is 24% (2009, NHTS). In 2010, the female share of daily bike commuters in the US was 24% (USDOC, 2010). In our sample, 26.7% of commuters bike to work daily, and 9.3 % are female, and 17.3% are male. We do not know about the number of trips made by females and males to compare with the national and state level, but this at least showed that the number of cyclists in Georgetown is relatively balanced. This is also a good representation that the gender ratio in cycling is close to the gender ratios of Georgetown, based on which we could assume that maybe

the infrastructure and facilities are accessible to both groups, but this still needs further study and will be address later in this article.

Our survey did not get any survey responses from the age of under 15 populations but covered all the other age groups. The age 15-17 group has the least number of people who have ever biked, with a percentage of only 0.6% of all participants ever biking in Georgetown. Three age groups at 35 and older are the majority of all cyclists in our survey sample. This may be because of the oversampling in some age groups as mentioned earlier, but since we did not have a targeting group when we spread the survey, this result is still representative of the cyclists in the city of Georgetown.

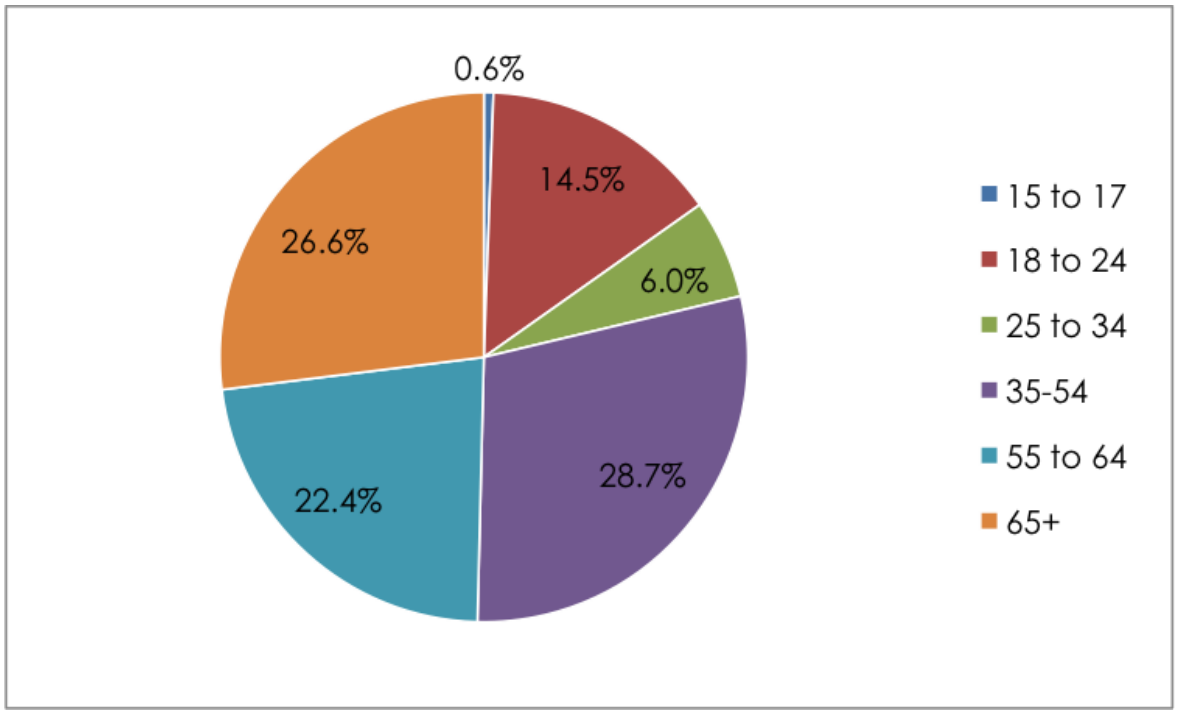

Figure 13. Cyclists by age groups

This result is very different from some studies on national trends. For example, cycling falls sharply with increasing age, and the bicycling group in the US is concentrated among children and young men, and inversely correlated with income.

(Schimek & Komanoff, 1999). In our results, the number of cyclists is increases with increaseing age, and the primary cycling group is concentrated among the age of 35 and above in our sample. In specific, the 35-54 age group is the largest group of people who ever biked in Georgetown, and 78.5% of the 35-54 group bikes for recreational or exercise purposes at least once a week. Surprisingly, 86.2 percent of the people age 65+ bike at least weekly for recreation and exercise. The result is very different from the national trend that young people are the primary group engaged in cycling.

Our sample covered all income and ethnicity groups in Georgetown. The majority, 81.2%, of our respondents are white, and 77.7% of them have biked in Georgetown: 64.7% of them bike for recreation or exercise at least weekly, while 18.8% percent of them bike to work or school weekly, and 12.1% of them bike for personal business at least once a week. Although the dominant cyclists by ethnicity are White, looking closely into the percentage, the second largest ethnicity group, Hispanic or Latino, are much more likely to bike in Georgetown since the portion of biking to work, personal business and recreation or exercise are all higher than the dominant ethnicity group. The percentage of minorities amongst the total cyclists in Georgetown is reflective of the national and general trend that the gap between whites and minorities in cycling is significant, but the percentages of cycling for different purposes are promising. A report about minority group cycling in American Bike League stated that the fastest growth of cycling is among the Hispanic, African American, and Asian American populations. Between 2001 and 2009, those three groups grew from 16 to 23 percent of all bike trips in the U.S. (1). And this growth rate is much higher than in the white population. In Georgetown, except the listed ethnicities above, the responses of the "mixed race" and "prefer not to say" together are 8% of all our responses.

The majority (51%) of our responses are from households that have over $100,000 household incomes, and 57% of our responses are from two-person households. The $100,000 income in our survey is the highest income group. The highest income group was much more likely to bike for “exercise and fun” while the less than $19,999 group was much more likely to bike to school, based on the fact that in Georgetown, this group is mostly college students.

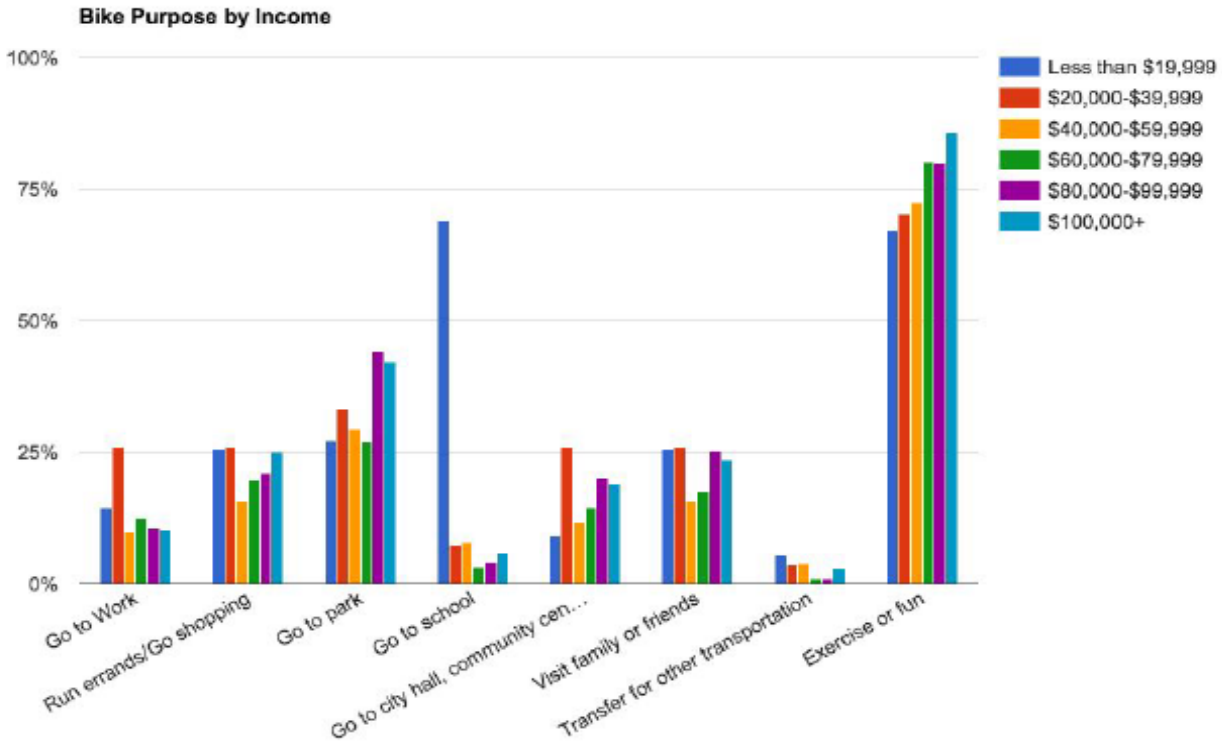

Figure 14. Bike Purpose by Income

The $100,000 income group biked more often than other groups, likelydue to them having more self-managed time than any other groups. This is also consistent with the national trend that the relatively wealthy households bike more. The two-person households bike rate is the highest (XXX). This could be the same case with the high-

income group: if a two-person household has no children, they would have more time to exercise or more time available to choose cycling as a transportation mode to get around without worrying about other time-urgent obligations.

Education is another thing worth mentioning in our sample in Georgetown. Georgetown has a high percentage of higher-educated population thanks to Southwestern University and the Sun City retirement community. The higher-educated people are much more likely to bike (ACS, 2001-1008), and this is the case in Georgetown. 66.3% of people who took our survey held a college degree or higher and 76.5 percent of those people bike in Georgetown. We were guessing the college students would be the major component of this higher educational group who bike more, but surprisingly, 54.6 percent of people who have a college degree or higher are at the age of 55 and older and 35.1% of them are between the ages of 35-54. This is unique compared to the national trend and the trend in Austin, where the dominant cyclists are white, relatively wealthy, young, and male.

Barriers of Bicycling in Georgetown

In our survey, we asked about the barriers they experienced in cycling and their concerns that stop them from cycling. The results may not completely represent all the cycling barriers in Georgetown, but are informative enough for us to understand the context in Georgetown. We combined the barrier-related questions from the intercept survey and online survey and found that the lack of bike infrastructure, specifically bike lanes and separated/off-street bike lanes, are the main barriers facing current cyclists and are also what would most encourage others to ride more. Following bike lanes, "personal safety," "narrow Street," "poor light," "no bike parking," and "no direct routes" are also

mentioned very frequently. In summary, the concerns are mainly about the infrastructure, the facilities, the routes, and the safety.

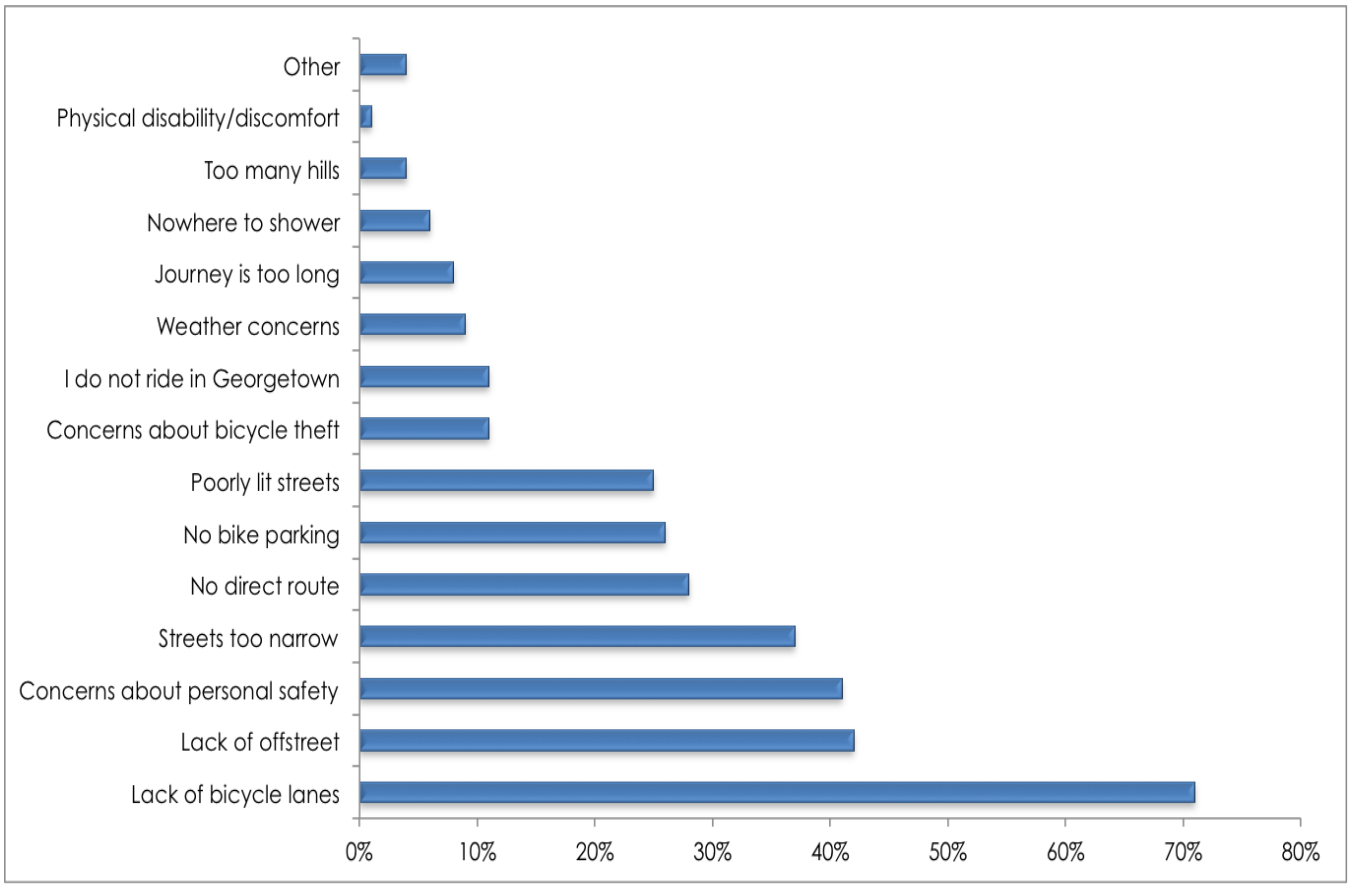

Figure 15. Cycling Barriers

701 of 915 responded to our barrier questions. 35% of people mentioned lack of lanes, which is also the highest percentage concern; among those, 22 percent of them chose lack of on-street bike lanes, and 13% of them selected the off-street bike trail.

As mentioned in the earlier section, our survey results showed most people bike for recreation and exercise, which could be accommodated by the bike trails. But the on-street bike lane is still the major concern, this indicates there's need for on-street bike lanes which could provide more than a recreational and exercise purpose. The presence of

fast-moving traffic and its presence on narrow streets was also one of the major barriers that respondents mentioned. These responses were usually tied in with barriers related to awareness and hostility. Responses showed that the speed limits were a huge problem for cycling, especially on major roads that connected important points in the city. Bicyclists had no alternate routes, but they also refrained from using these routes either due to concerns about safety, because cars did not expect bicyclists, or because of hostility, where bicyclists were sometimes yelled at for slowing traffic down. Concerns about personal safety formed about 13% of the total barriers cited. Bad lighting and the lack of spaces to park bikes is another small but important barrier that bicyclists experienced. Natural barriers, such as the presence of hills and physical discomfort, formed a very small section of the total barriers (less than 3%). About 1% of the people reported the lack of sidewalks or their unsuitability for biking as a barrier. Some respondents who mentioned sidewalks also talked about their concerns about having to share a right of way with pedestrians who did not leave “room” for biking on the sidewalks. This is a clear reflection of the lack of awareness about biking and the proper infrastructure required. While the lack of bike lanes remains the most commonly cited barrier, concerns about personal safety, narrow streets, and concerns about theft are higher in riders than in the interested but concerned population, and the journey being too long and too many hills were cited as barriers by more of the interested but concerned population.

While reviewing the barriers in general, a close look at the people that have concerns about different barriers could help us better understand the difficulties. We asked people about their self-identity regarding cycling, we compared the "enthusiast" and "interested but concerned." More "Enthusiast" cyclists reported barriers in most of the concerns except in the "journey too long" and "poor light" categories.

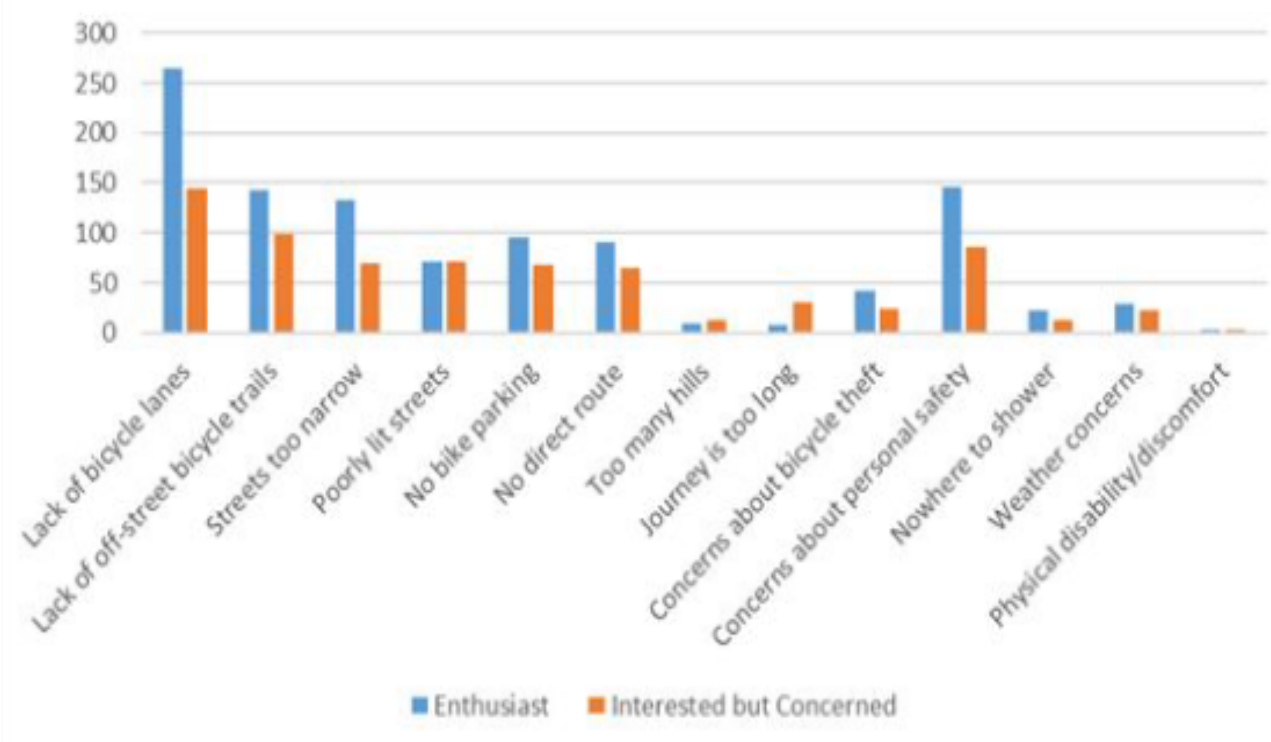

Figure 16. Cycling Barriers by Type of Riders

Looking at the "interested but concerned" group, 64.2% are female; this is inconsistent with the results from other studies that females are much more sensitive to the cycling barriers. Surprisingly, 94.1% of people who are interested but concerned own at least one bicycle in their household, and 84.3% of them still bike at least once a week. And looking at how far people bike, the majority of interested but concerned people bike 2.1 to 4 miles. When looking at barriers for different age groups we could see the passion for cycling in Georgetown is very high, but also, the challenges and potential of growth are great too.

Environment Audit

For the 24 locations that we conducted the environment audits, 12 places had some cyclists when we conducted the audits, one place had many cyclists, and in 11 places we did not see cyclists. Seven places had no pedestrians and 17 had pedestrians. 20 places had no dedicated bike lanes and four places did have dedicated bike lanes. 12 of the locations had a two-lane street, seven sites had four lanes, and five places had five lanes. 22 locations were smooth and stable with no obstacle on the path and 2 of them had some obstacle on the road. Seven places did not have excellent visibility for all users, which could cause safety problems. 13 places had no street lighting, and 16 places had no bicycle parking nearby.

During our auditing, ten places had people cycling the unmarked shared path, and nine places found people cycling on the sidewalks. Only in 3 locations did we notice people cycling on the protected bike lane, and 2 locations had people cycling on the broad shoulder. The labeled speed limits at the locations are varied: 16 places had speed limits under 35 mph, five places were under 25 mph, and only one place was under 15 mph. The speeds below 20 mph are considered the safe speeds for pedestrian and cyclist from the injury data (Pucher book, p143). 6 places do not have clear signage and markings. We also asked about the surrounding land use of the dominant place.

From the sample audit result, we can see the cycling infrastructure in Georgetown still needs to be improved: dedicated right-of-way for cyclists, visibility on the road for all users, street lighting, bike parking, and signage are needed. Also, from the safety perspective, since most cyclists are seen riding on the on-street shared path, the street segment became very important, including the speed limits, the signage, and the streetlights, where more than half of the places are missing those and have an unsafe speed for cyclists.

Factors that were Affecting Cycling in Georgetown

From the previous section, by comparing Georgetown's socio-demographic factors with national levels and other places, the study found that Georgetown was very different from other places. The most impressive part is that the majority of the cyclists in Georgetown are at the age of 35 and older, and the number of cyclists grows as the age group increase. The number of female cyclists is relatively high and the number of female commuters is relatively high. Even though the trend of income, race and, educational attainment of the cyclists are consistent with national levels, Georgetown still has its uniqueness in different perspectives. For example, the percentage of Hispanic cyclists who bike to work is more than the percentage of white cyclists; the lowest income group was much more likely to bike to school than any other groups, and the second lowest income group much more likely to bike to work and city hall or community center; Black or African American cyclists were much more likely to bike to work and run errands than any other ethnic group, while Asian cyclists were more likely to bike to work, school, and transfer to another transportation mode. Based on these unique qualities, I decided to take a close look at age and gender, explore their behaviors and preferences and get some take-aways as user-based factors that have bike planning implications.

Inspired by the methods that measure user experience, I chose three types of questions to further examine the characteristics of the factors in Georgetown that have different results with the national and other places. The three categories are age, cycling behavior, and perception. The analysis will focus on the characteristics summarized from the first-round cross tabulation analysis.

Cycling and Age in Georgetown

Based on the first-round analysis, people age 35-54 were the majority of cyclists in Georgetown, but if we add people from the 55 to 64 and 65+ groups together, it's 49 % of the cyclists group, which indicates that the senior people are the main group of cyclists in Georgetown. This could have different reasons. First, Sun City, the retirement community, is based in Georgetown which leads to a concentrated retirement-age population. Second, golf carts are used as a common transportation mode in Georgetown, and bicycles are a very close viable substitute. (Pucher book, 282). Third, during our interview with Sun City residents, many of them indicated they used to lived in bike-friendly places before, for example, Boulder, Colorado, cities in California, etc. Since they are the leads of the cyclists in Georgetown, it is important to know about them, and what are the differences between them and other age groups of cyclists.

Cycling Behavior

14.5 percent of total cyclists bike to work. To avoid the specific group over sampling problem, the rate was calculated in the age groups instead of the total number of people who bike to work. Based on the result, the 25-34 age group is the one most likely to bike to work and following is the 35-54 group and the 18-24 group. It is obvious that people at the age of over 65 are the least likely to bike to work which is in accordance with the fact that this age group is mainly retired people.

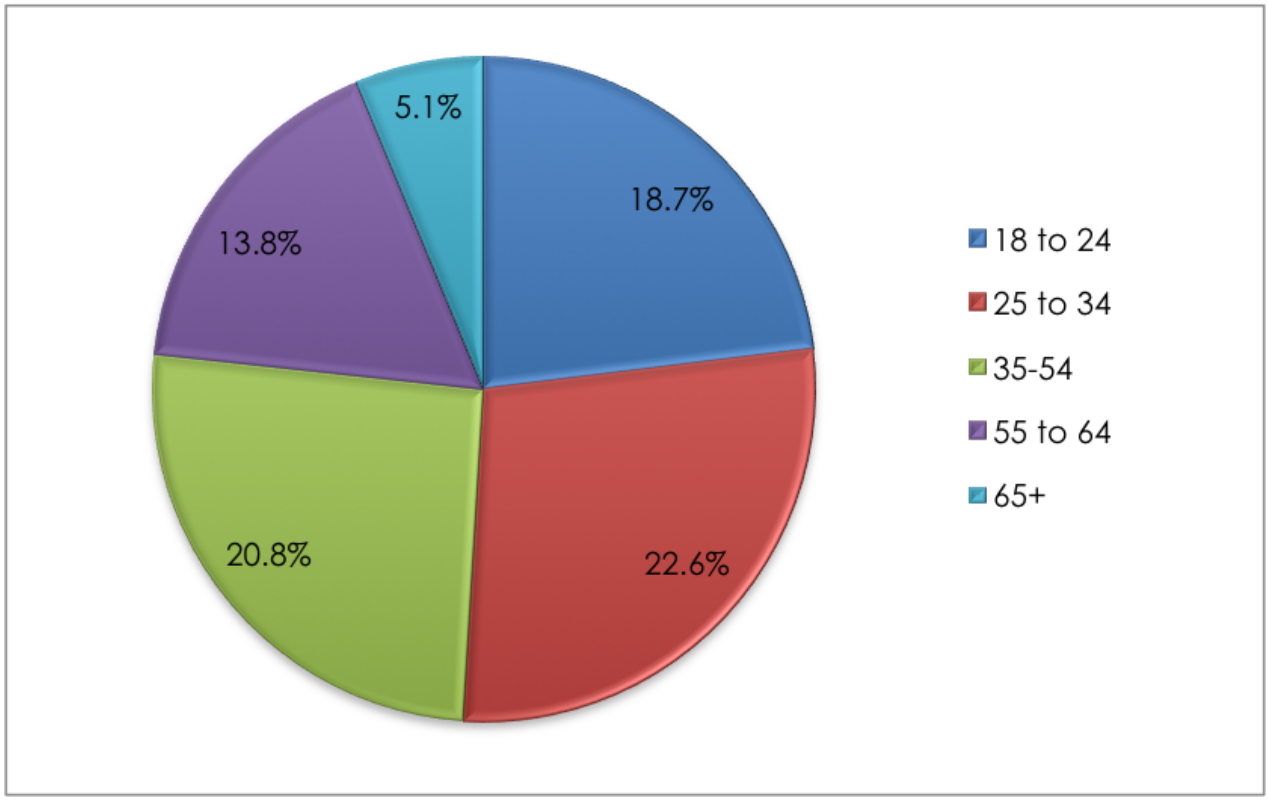

Figure 17. Cycling Barriers by Type of Riders

Looking at the frequency for different trip purposes for different age groups, among people who commute by bike between home and work or school, the 18-24 group has the highest propensity in bike to work or school "daily," and the same propensities in bike to work or school "a few times a week," and "monthly," while the 55 to 64 age group has the highest percentage (78.4) who bike "a few times a week"

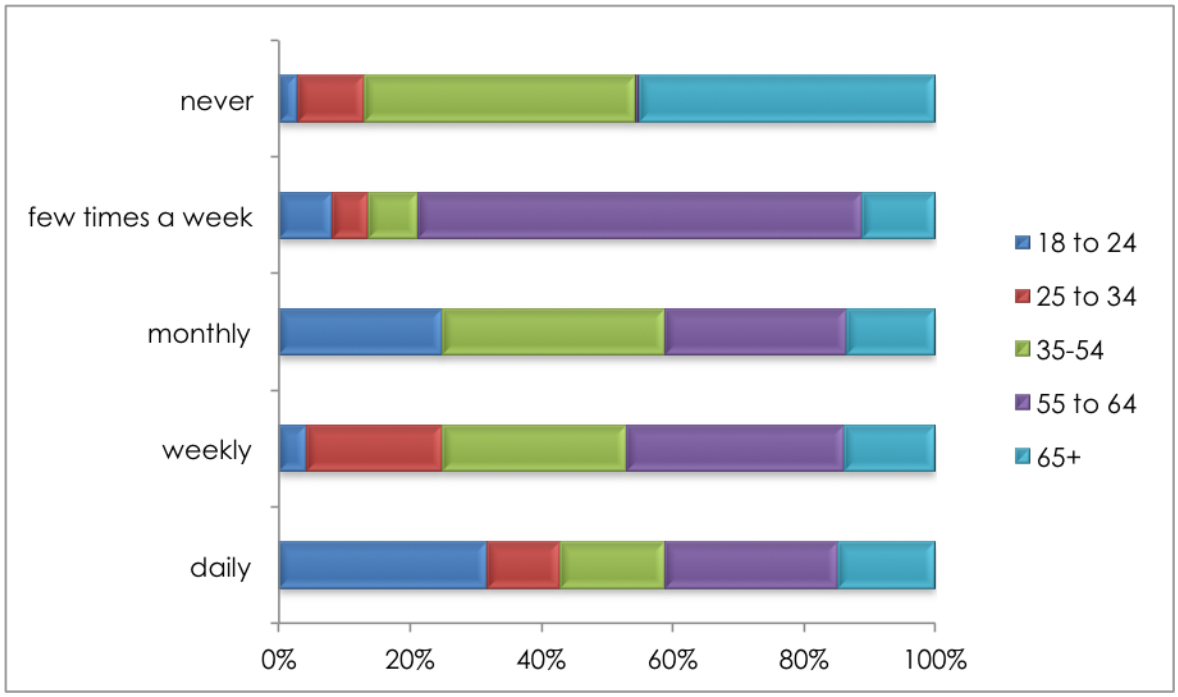

Figure 18. Bike to Work or School

Comparing the frequency of biking for personal business and recreation or exercise, the 55 and over group still holds the highest percentage, while 56.9 percent of cyclists at the age of 55-64 bike "a few times a week" for personal business, and 63.8% of cyclists at the age of 65 and above bike "a few times a week" and 35-54 age group cyclists are the least likely to bike for personal business.

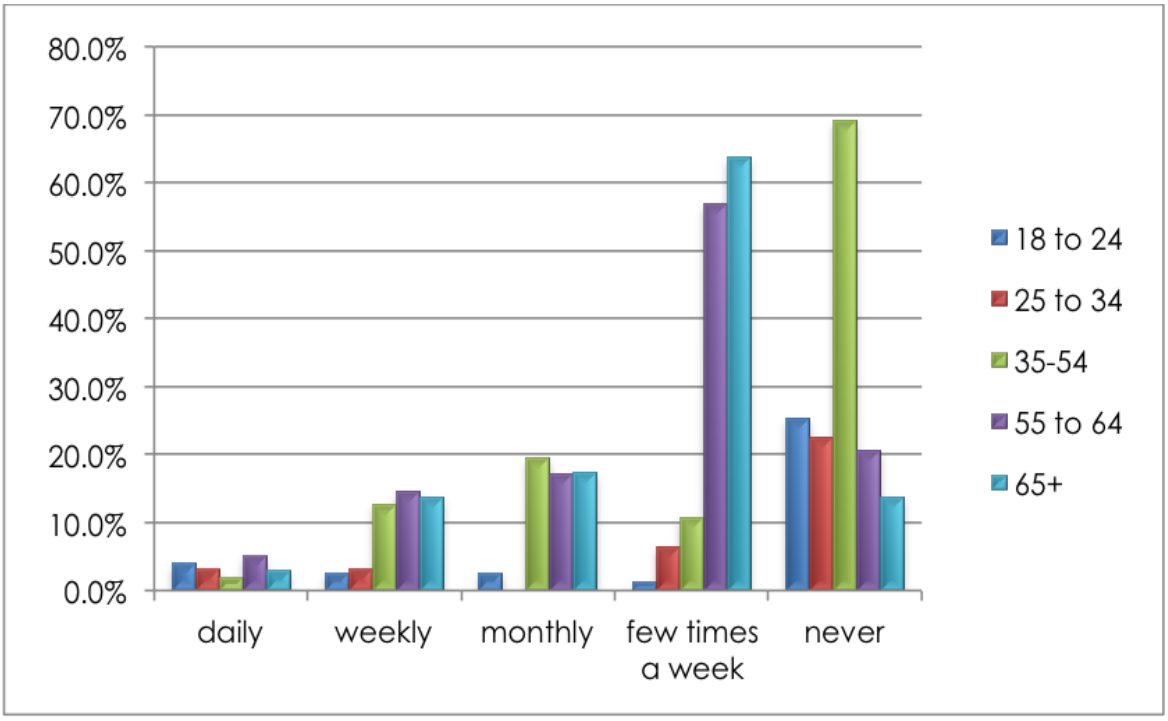

Figure 19. Bike for Personal Business

The recreation or exercise purpose is the most positive trend; all age groups showed high propensity in biking at least once a week for recreation or exercise. But the interesting trend is that the 18-24 age group had the highest percentage of "never bike for recreation" while the number drops as the age increases. People at the age of 65 and over are still the group that is most likely to bike for recreation at least once a week, and the likelihood of biking for sport or exercise is increasing with age.

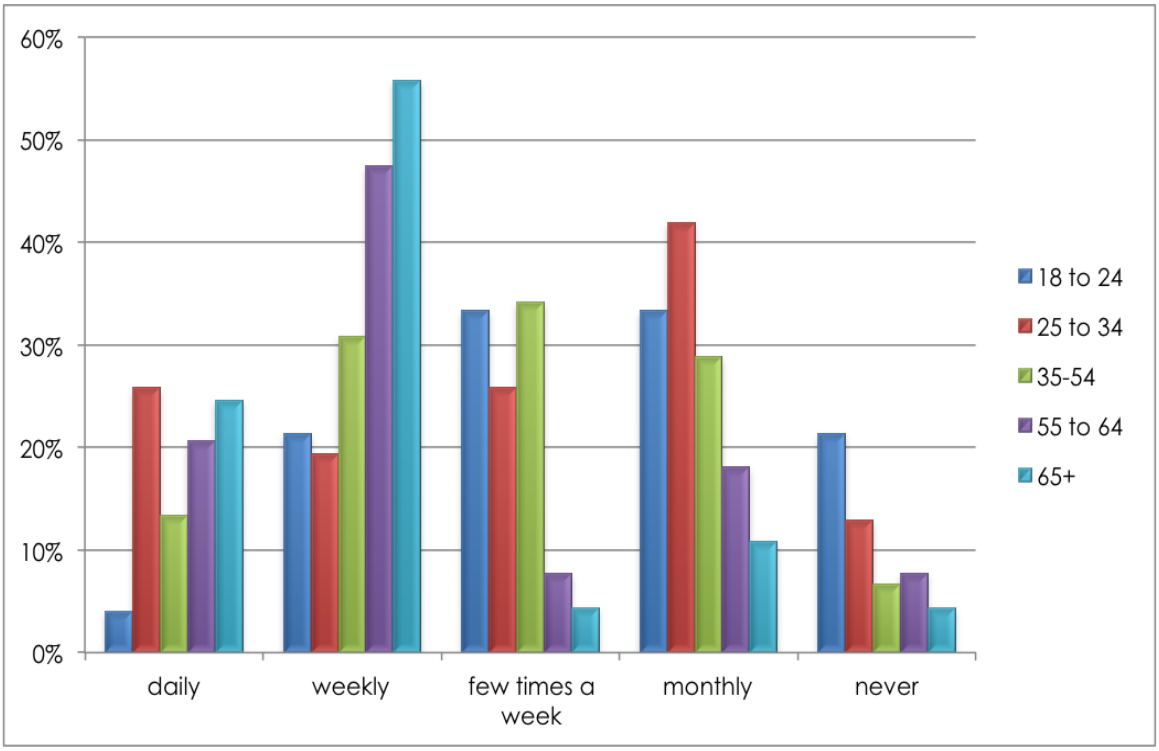

Figure 20. Bike for Recreation and Exercise

When asked "what time do you usually bike?" all age groups tend to bike slightly more on weekends than weekdays, except the 18-24 and over 65 cyclists, who bike more on weekdays. 7-9 am and 4-6 pm are the peak times for biking. The likelihood of cycling among people at the age of 65+ decreases after 7-9am, this could be due to different health conditions.

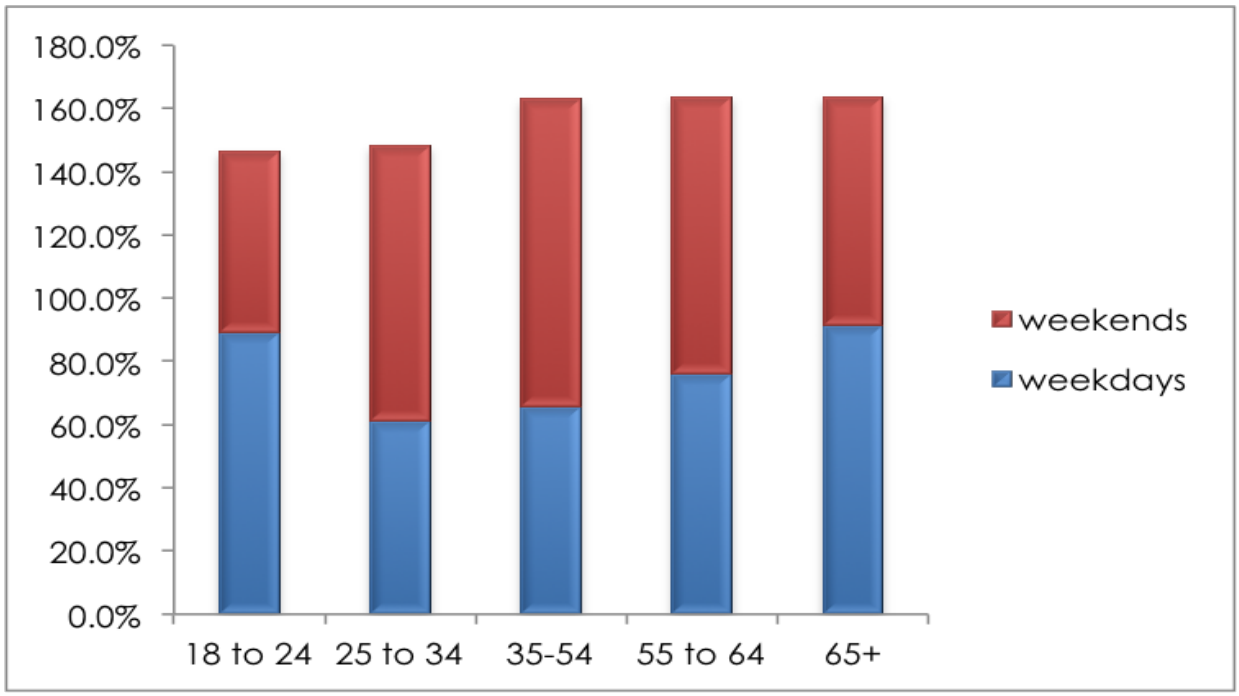

Figure 21. Preferred Bike Day During the Week

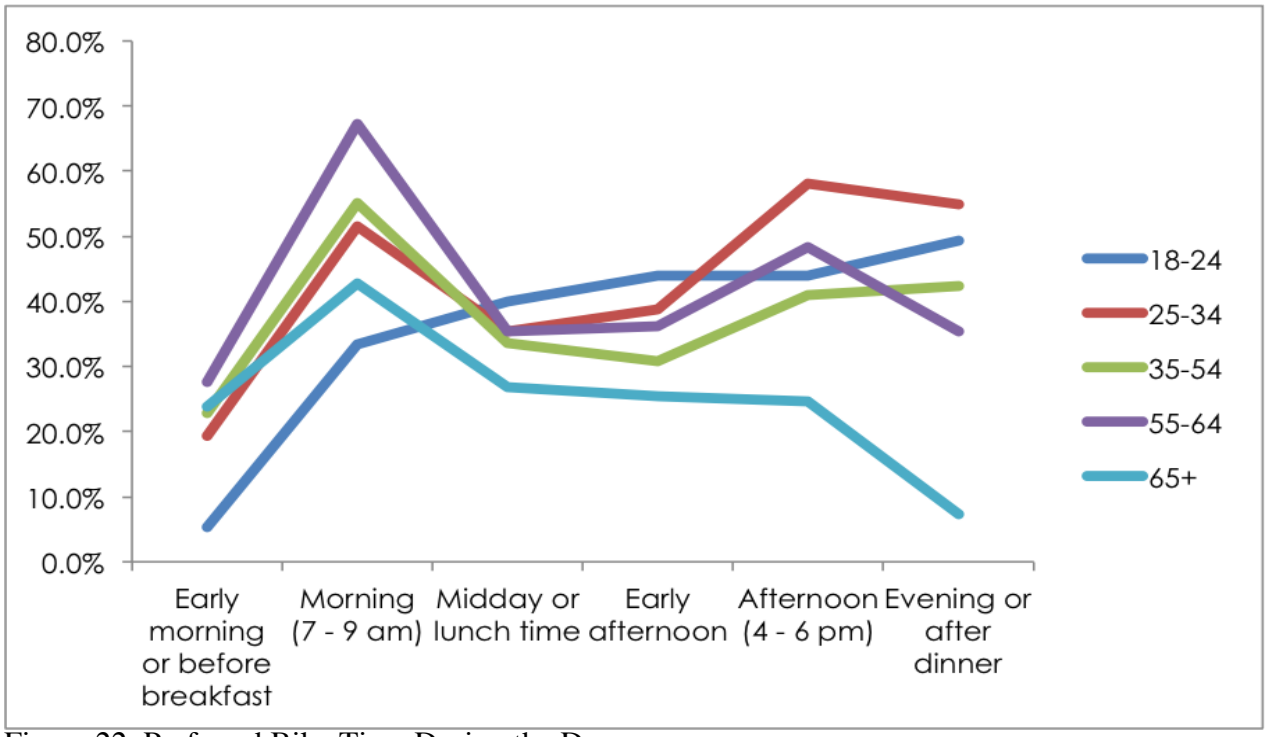

Figure 22. Preferred Bike Time During the Day

After knowing the purpose and the preferred time of cycling, the last thing for cycling behaviors is "what type of path do they use?" People at the age of 55-64 and 65+ tend to have the same preference, they prefer the neighborhood street most and the sidewalk least, and 76.1% of 65+ cyclists prefer to use the major streets and on-street bike lanes more than any other age groups.

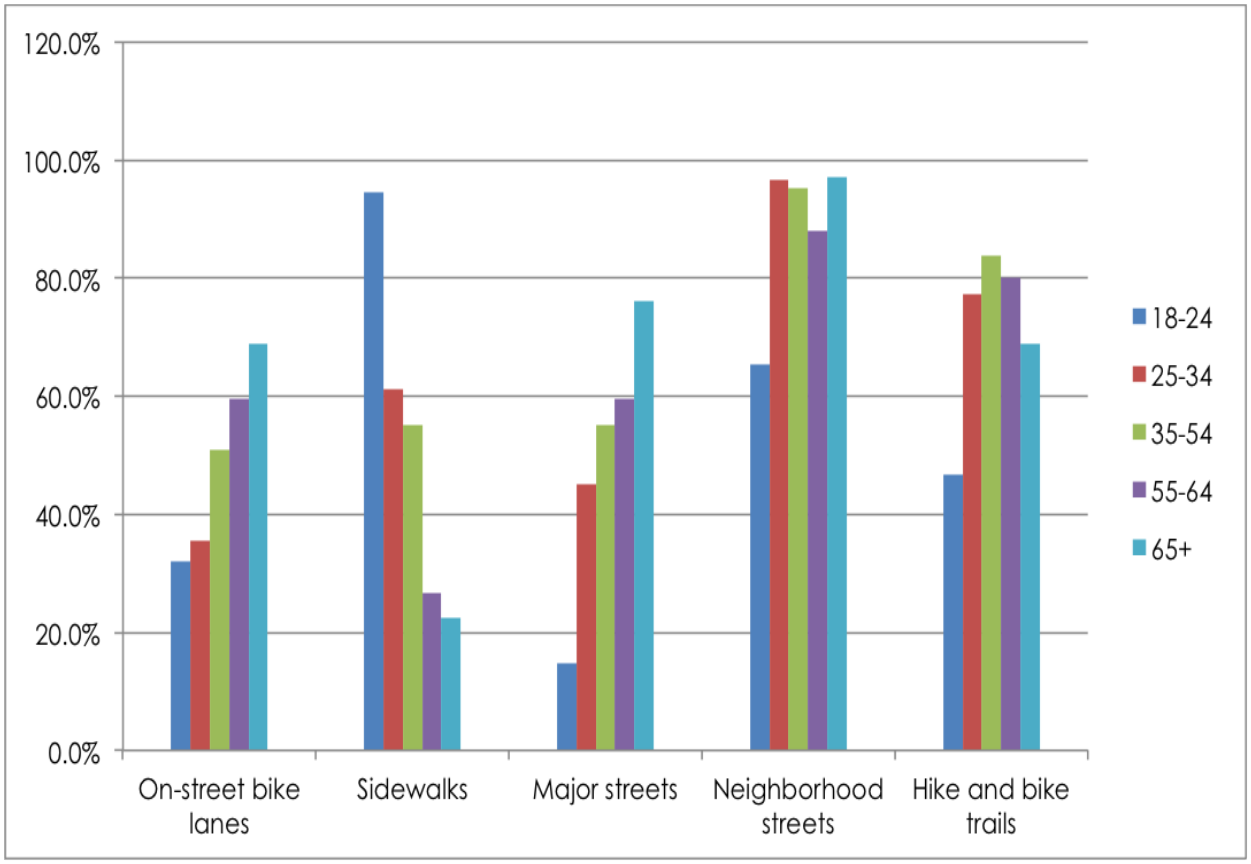

Figure 23. Preferred Bike Facilities

Perceptions

Perceptions are about how people feel about the environment and how much the environment affects their choice. When asked "Was a bicycling-friendly area an important consideration in your choice of where to live or work?", the importance of cycling-friendly areas increased with age, except the minor drop in the 55-64 age group, and this consideration is most important for people at the age of 65 and older. The reason is the fact that senior people are much more sensitive to the environment and value their comfort of life. People at the age of 65+ are the most sensitive group among seniors. They are much more likely to encounter some physical limitation caused by aging. Overall, more than 50% of the cyclists in all age groups (except the 18-24 age group) think that living and working in a bike-friendly area is very important.

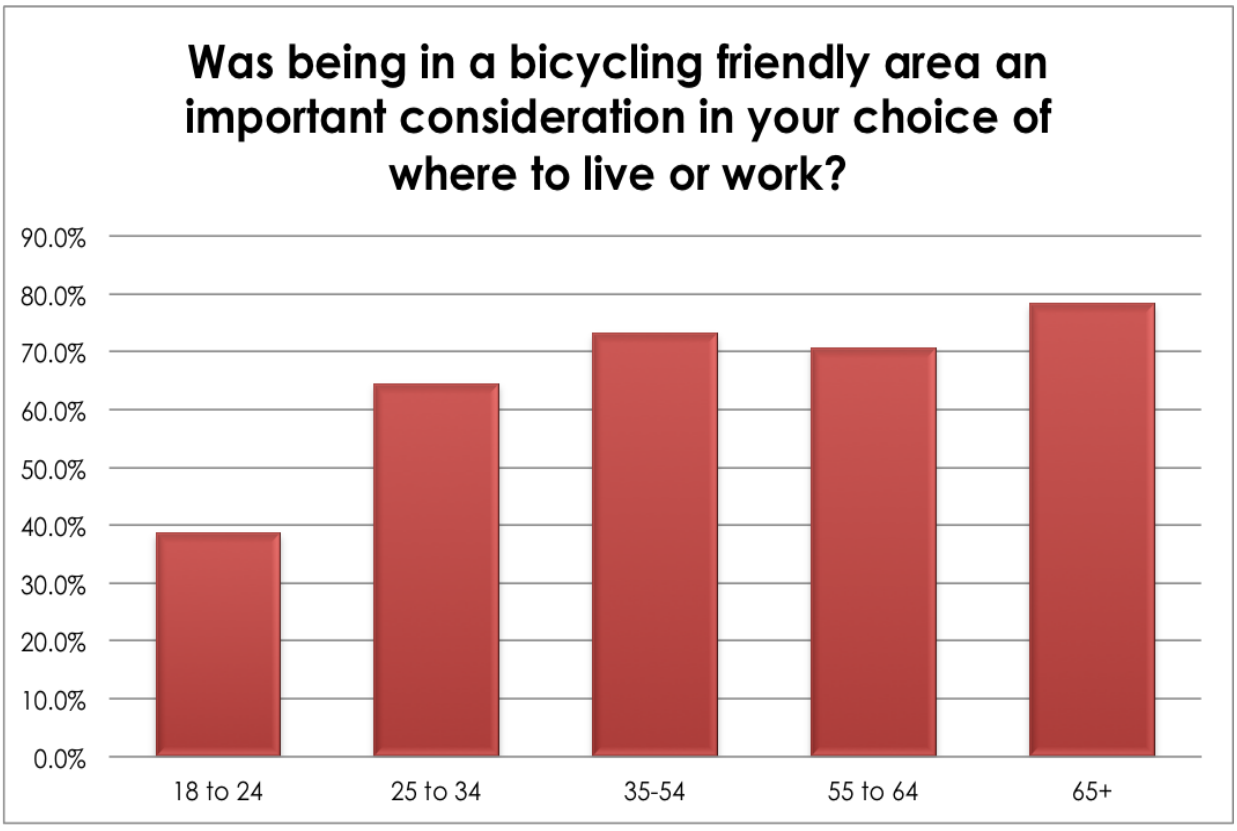

Figure 24. Was being in a cycling friendly area an important consideration in choice of live or work

When looking at the attitude towards cycling, the number of enthusiastic cyclists increased with age, and the percentage of "interested but concerned" riders had the opposite trend. In each age group internally, the 65+ age group had the most enthusiastic riders, while the 18-14 group had the least. The 25-34 group had the most "interested but concerned riders" while the 65+ age group had the least. The 35-54 age group had the least "not a rider" responses, which is consistent with the previous result of 35-54 age group, which had the most riders.

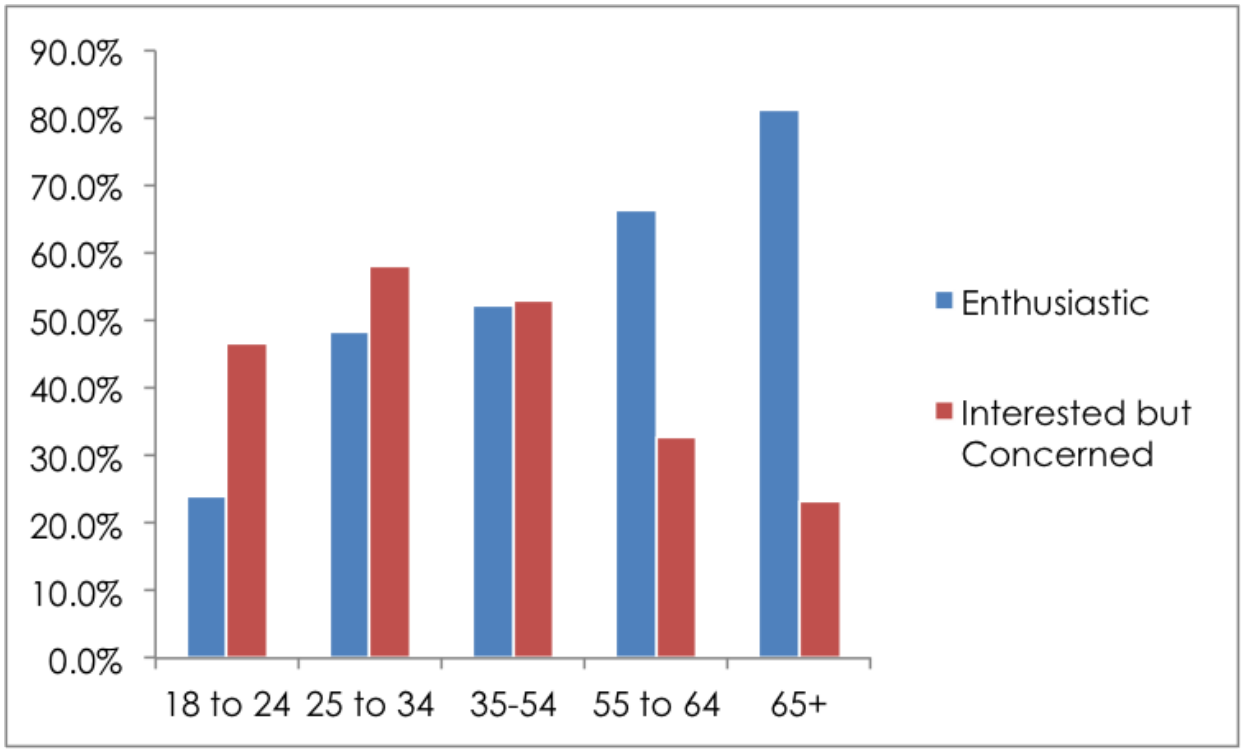

Figure 25. Preferred Bike Facilities by Age

Besides the results from our survey questions, we also know there are several active senior cycling clubs in Georgetown. For example, The Sun City Cycling Club.

Cycling differences by Gender

Based on our population projection, we found that the population of women surpassed the population of men in 2005. Then we became interested in finding out how women's responses to the questions are different from men's, and what their preferences are regarding cycling. There were 483 participants answering the gender questions with 250 males, 225 females, six who chose not to disclose their gender, and one who chose the "other" gender option.

Among those respondents, 95% of the female and male respondents live in Georgetown, 36% of the female respondents work in Georgetown, and 25% of the respondents live and work in Georgetown. 24% of females and 20% of males bike in Georgetown. In our survey samples, more women live and work in Georgetown and more women biked in Georgetown.

What's interesting about our result is that the majority of both the female and male respondents are people who are 55 and above (47% female, 62% male). Female respondents between 35-54 is the second largest group in female respondents with a percentage of 41, while men at the age of 65 and above hold the most percent (38%) of all male respondents. That is to say, the majority of the people who responded to our survey are middle-aged and elderly people. Based on this result, we could say that middle-aged and elderly people present the majority of the active cyclists, the bike advocates, or people who care about cycling in the city of Georgetown.

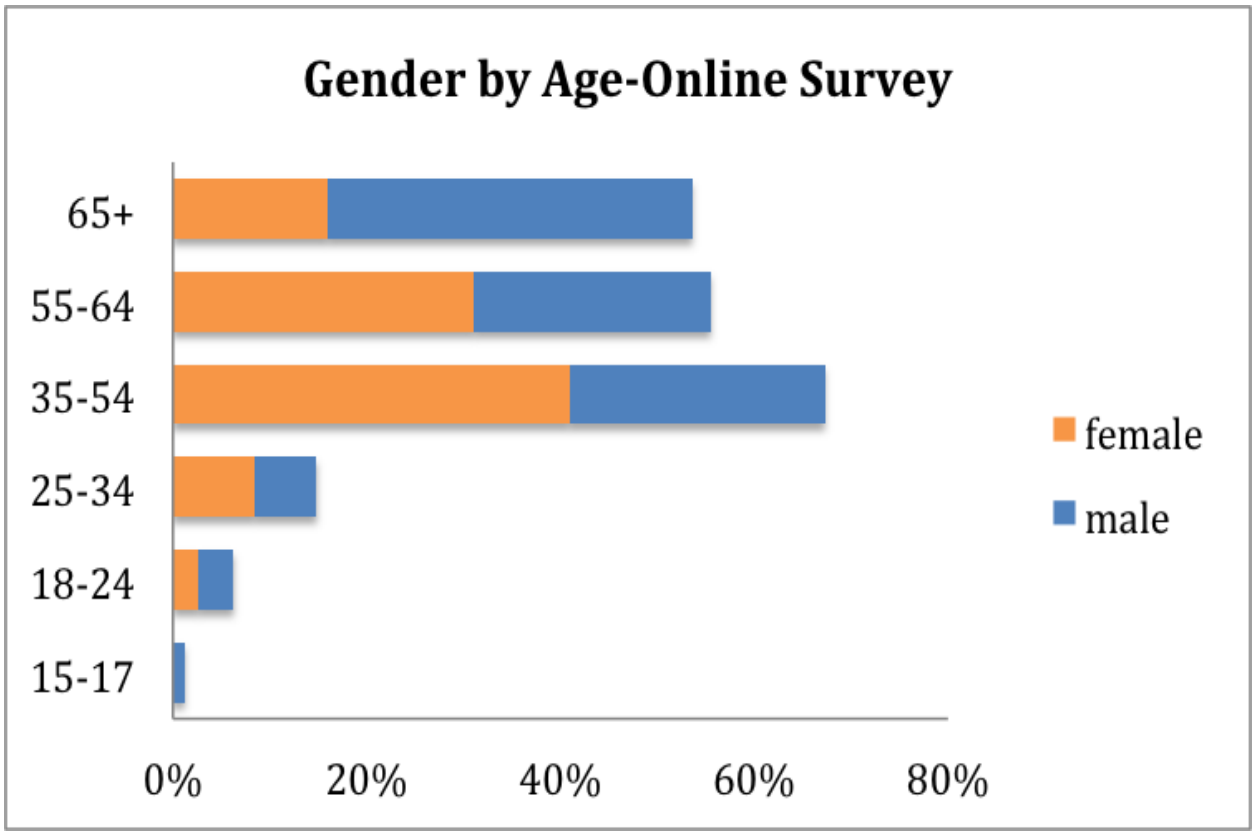

Figure 26. Gender in Online Survey

We asked people in Georgetown about why they bike, and the response was that most people biked for exercise or health whereas fewer people biked for their daily commute such as to go to work or go to school. Almost nobody biked to other transportation, mostly due to the absence of the transit system. From the result, women are less likely to bike for exercise with an 11% lower percentage than men.

Based on the trip purpose, we asked about the frequency of three major biking trips. They are "bike home and to work or to school," "bike for personal business such as going to the bank or run errands," and "bike for recreation or exercise purpose."

Most respondents never biked for a daily commute, but among people who biked home and to work or to school, less female respondents biked weekly or a few times a week and were much less likely to bike daily than men. According to a study in 2010, "Women were more likely than men to be possible or occasional cyclists, while men were more likely than women to be regular cyclists" (Heather,2010). This might explain our result. Regarding the sharp number drop in the "daily" category, it may imply that women are less likely to use cycling as a daily commute mode.

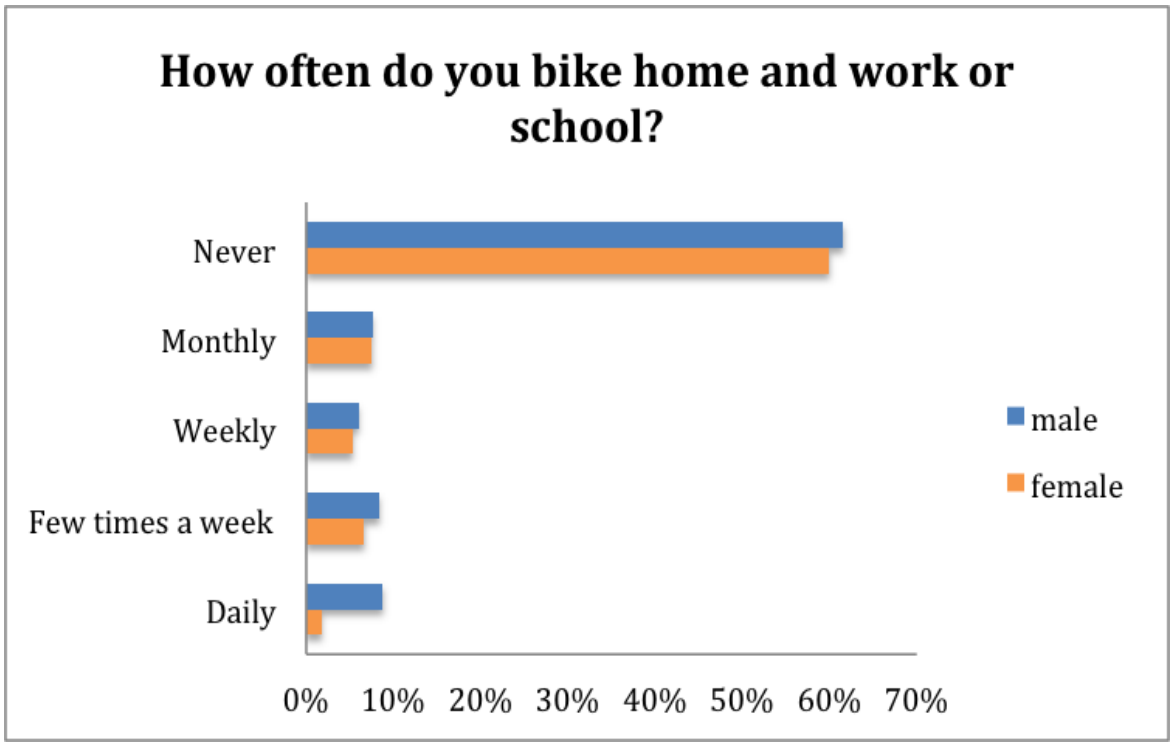

Figure 27. How often do you bike to work or school?

The trend of the personal business category happened to be mostly the same as the daily trip. Women were less likely to bike for a personal errand. But compared with the result of the last question, more people bike for personal errands than bike for their daily commute.

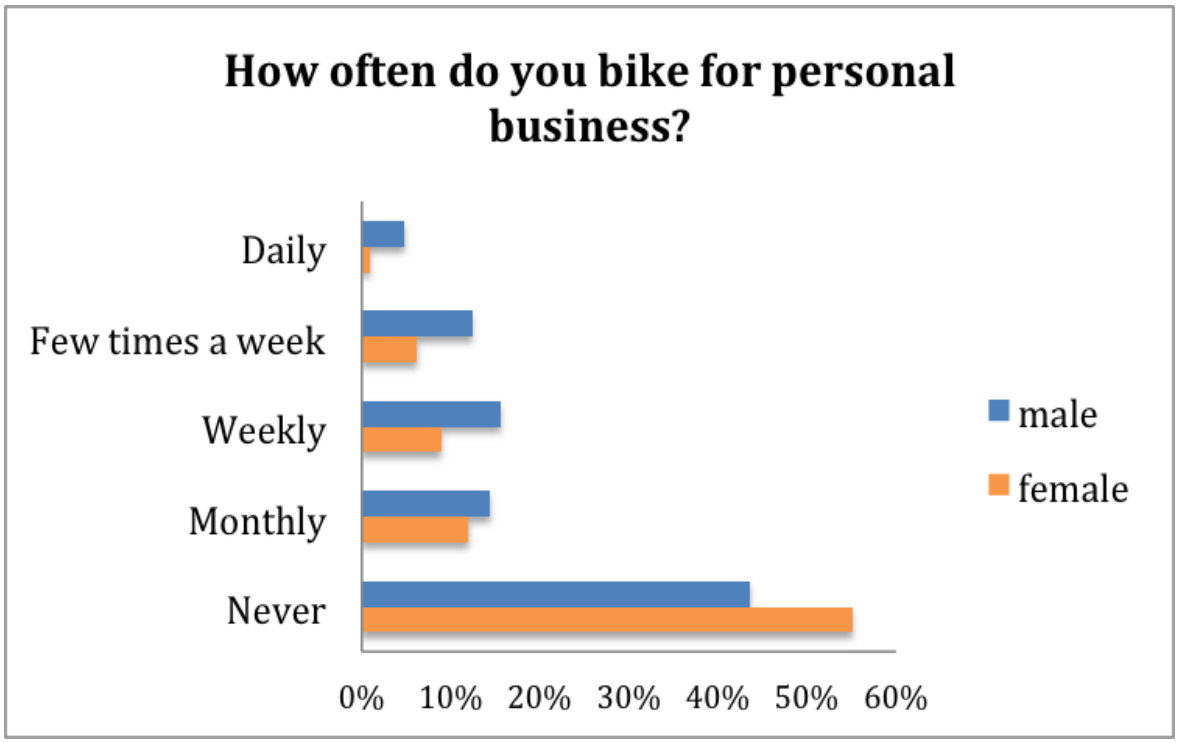

Figure 28. How often do you bike for personal business

The last trip purpose question we asked was about the frequency of biking for a recreational or exercise purpose. The result is almost completely different from the last two questions. Most women biked for recreation at least once a week; the majority of the female respondents biked for recreational purposes a few times a week which is similar to male respondents although with less percentage. The percentages of female respondents are almost evenly distributed between "monthly," "weekly," and "a few times a week" while male respondents are highly concentrated on "a few times a week." This coincides with the findings of the study that women are more likely to be possible or occasional cyclists than men, while men were more likely to be regular cyclists than women. (xxx) Furthermore, in recreational biking, women surpassed men with 6% biking for recreation monthly.

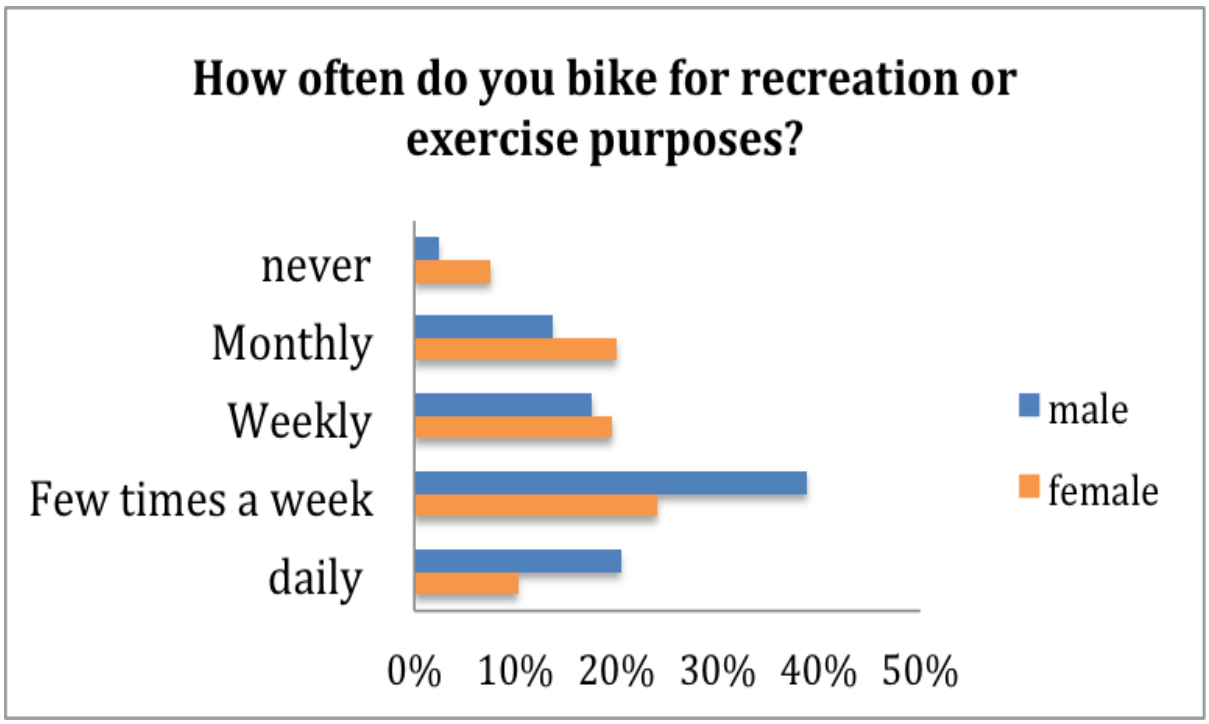

Figure 29. How often do you bike for recreation or exercise?

The different results of the three different trip purposes above are mainly due to the reality in the city of Georgetown which lacks on-street bike lanes connected to trip destinations but has a very popular recreational bike trail system that serves a lot of citizens. From the result of three different types of cyclists surveyed, we could see that women are much more likely to bike occasionally and for recreational purposes.

Preferable biking time and the trip destination is the next thing we are comparing. We asked the respondents for their preferable bike day during the week and preferable period during the day. More female respondents prefer to bike on weekends than weekdays while male respondents are slightly tilted to weekends as well. So apparently,

there are a lot of changes which need to be done to encourage women to bike on weekdays.

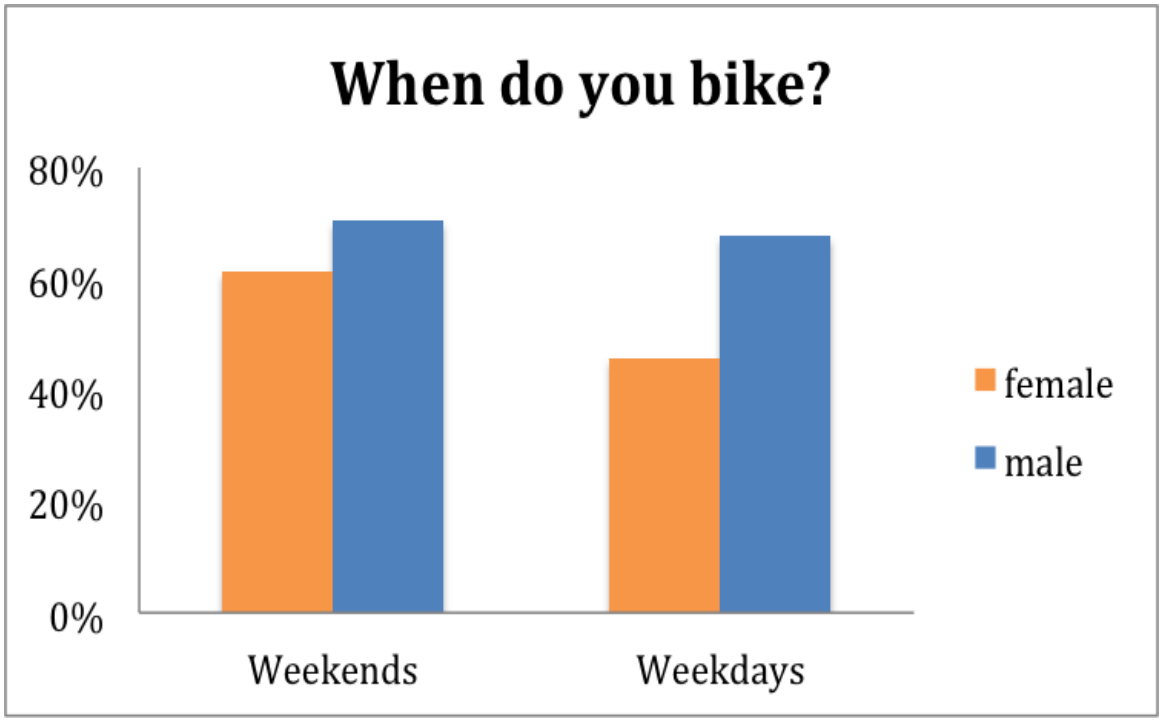

Figure 30. When do you bike

Taking a closer look at the preferable period during the day, 41% of the women and 55% of the men prefer to bike in the morning between 7-9, which is also the most preferable time for both gender groups. The second most popular time is 4-6 in the afternoon also for both gender groups. What else needs to be mentioned is that the percentage of female respondents is slightly higher than that of the male respondents. That is to say, women are a bit more likely to bike in the evening than men in Georgetown. By comparing these results with the car peak time during the day, it will be

beneficial to see a relationship between bikes and cars if on-street bike lanes will be added.

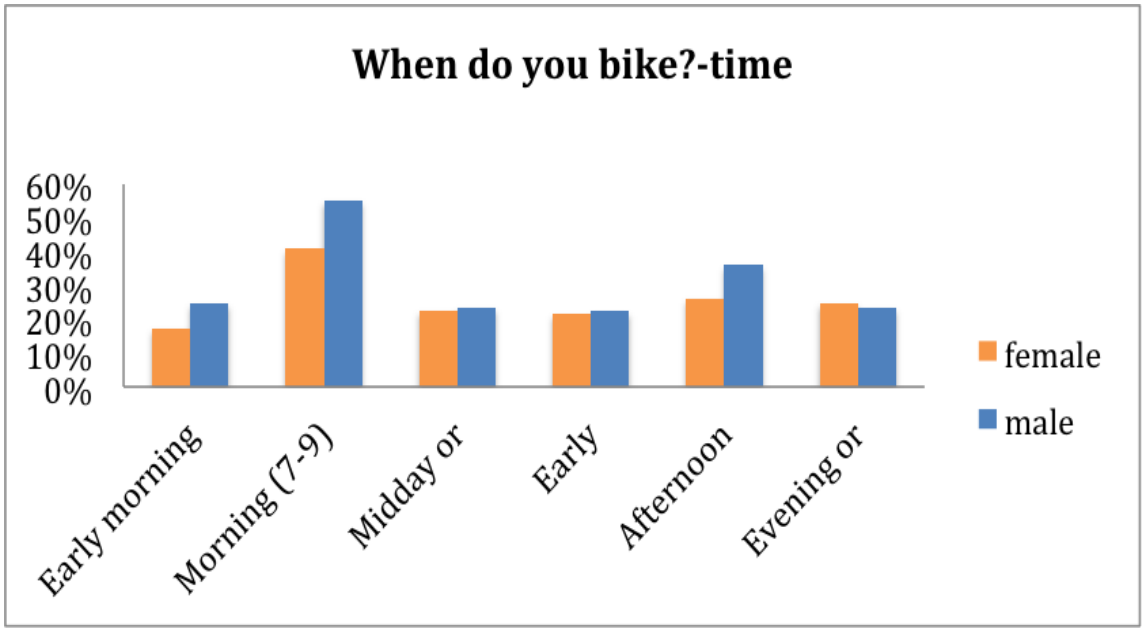

Figure 31. What time during the day do you bike?

After the time preference, we looked at the location-based questions like "where are your most common non-work trips within Georgetown (by any means of transportation)?". For this question, we compared the number of responses at each place which could be referenced as a popular destination that potential bike trips would be connected to. The shopping center, school, downtown, library, and place of worship are much more popular among women, while restaurants, parks and trails, sporting facility, and neighborhood stores are much more popular among men.

Figure 32.Non-work trip destinations in number

To see the different preferences of women and men, we compared the percentage of each group, which implies the location for potential cyclists. With this percentage, the result slightly changed. The restaurants are as popular among women as among men, the gap between shopping, downtown, library, and place of worship is much broader while the gap between parks or trails and neighborhood stores is shrinking. This result may suggest how to make the destinations that women or men prefer much more convenient for them, and how to make the places that women or men are less likely to go to much more attractive to them. Also, this is helpful to find the potential bike destinations and how the connecting routes should be.

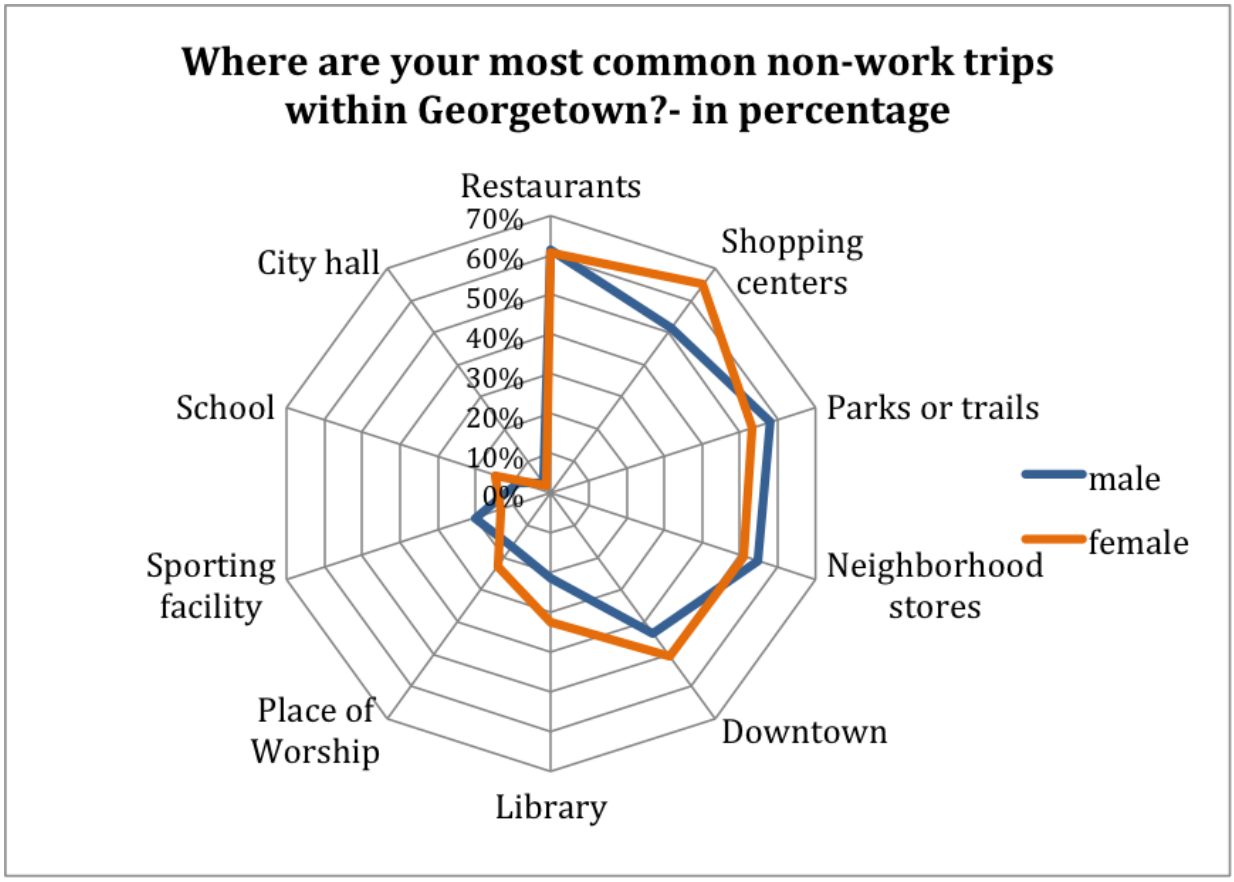

Figure 33.Non-work trip destinations in percentage

Considering all the above, we were trying to find out what are the incentive factors and barriers which affect people when they are cycling. It turned out that women are much more sensitive to hills, bike theft, poorly lit streets and lack of off-street bicycle trails than men. By fixing those barriers, the percentage of female cyclists would likely increase.

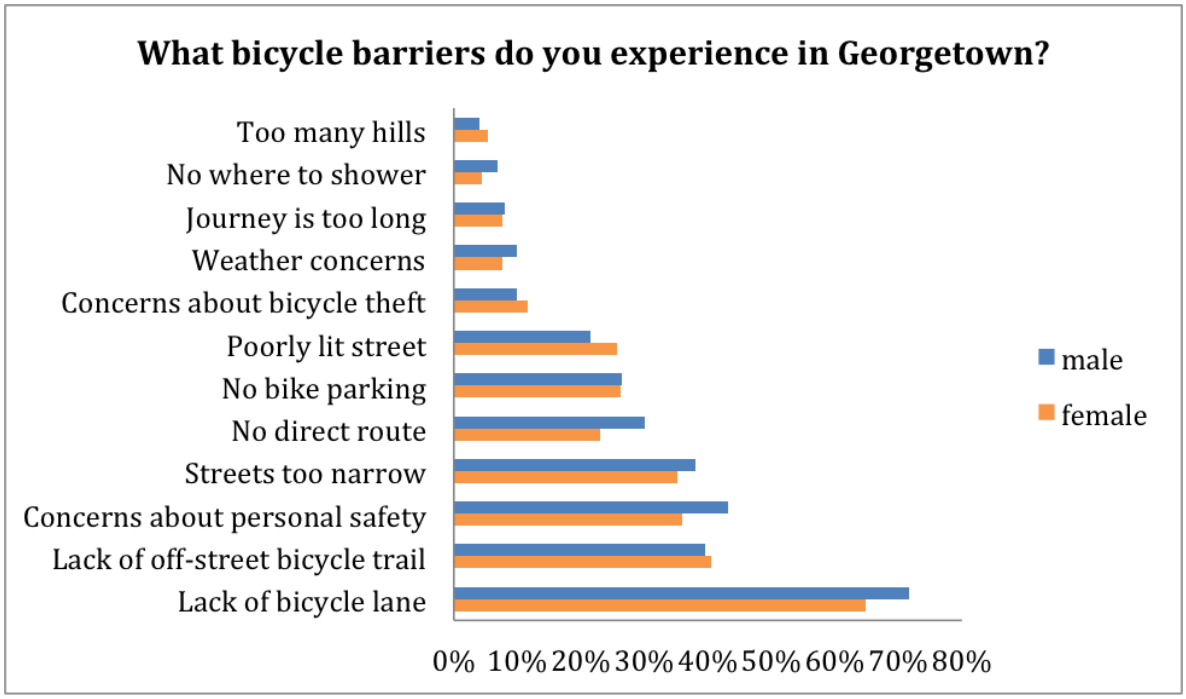

Figure 34.Bicycle barriers by gender

After the concerns and barriers, we also asked about "what would encourage you to cycle more?" The result complies with their preferences and concerns we analyzed before. Places with off-street bicycle trails, safe bike parking, better street lighting, and better traffic signage as well as shopping centers, schools, and parks nearby will encourage women to bike more than men. Men are much more encouraged by dedicated bike lanes, paved shoulders, better connectivity to bike facilities, and better traffic enforcement. Based on this result, we can tell that women are much more sensitive to the surrounding environment when biking while men are more concentrated on the conditions of the road. This finding may lead to different bike lane designs in various areas.

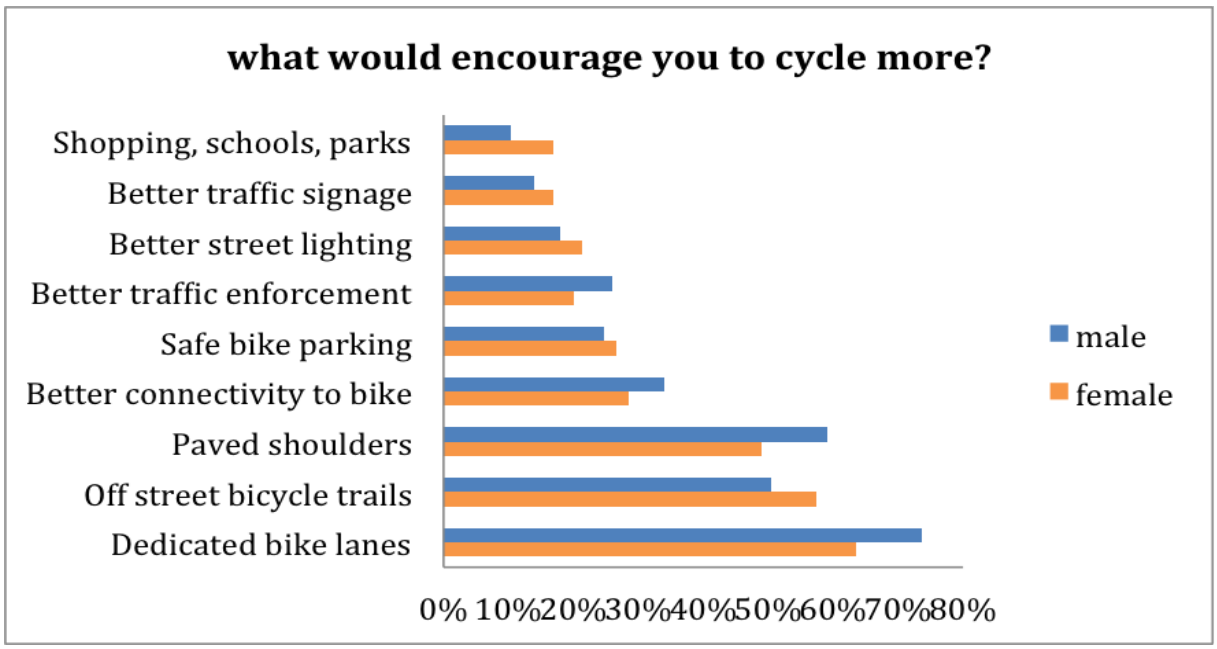

Figure 35.what would encourage you cycle more?

Another question was “Being in a bicycling friendly area is an important consideration in your choice of where to live and work." The result showed that half of female respondents said yes and half of them said no, while the 60 percent of male respondents said yes and 40 percent said no. This result indicates that men are much more likely to choose a bike-friendly area as their living and working place in Georgetown.

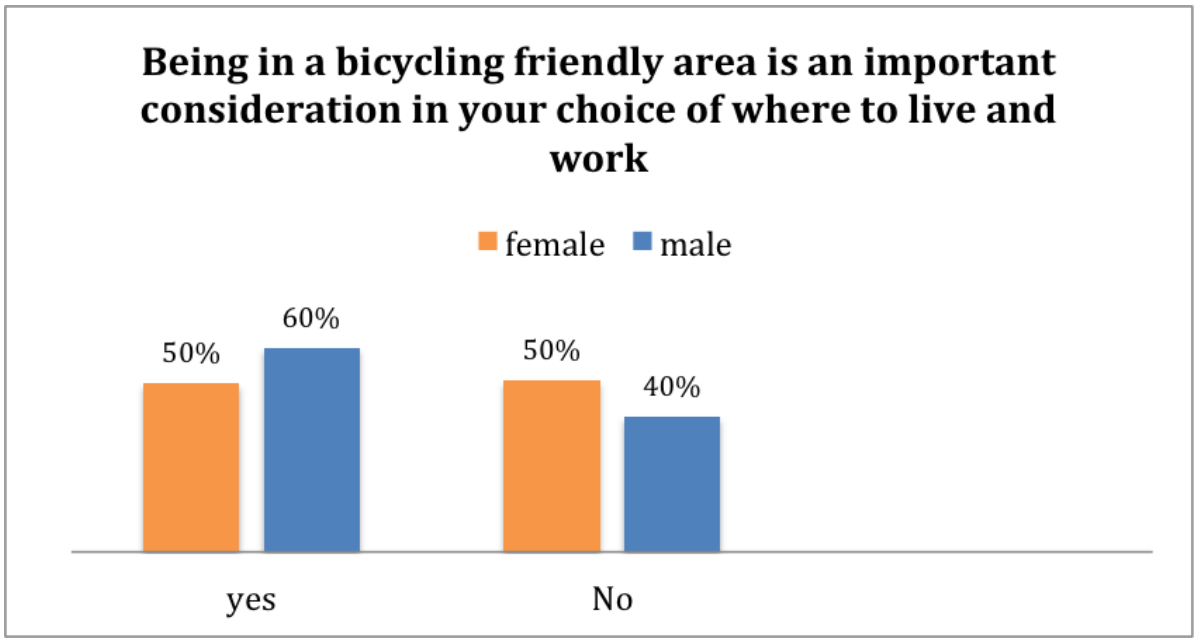

Figure 36. Was being in a cycling friendly area an important consideration in choice of live or work-by gender

After discovering all the differences based on gender, we became interested in finding out how those respondents define themselves as riders. We asked "What type of rider are you?" The majority of male respondents (69%) define themselves as "enthusiast" riders, which complies with the outstanding percentage of recreational biking frequency. 43 percent of female respondents positioned themselves as "interested but concerned." This result could identify problems of the most popular destinations and barriers and show where and what kind of improvement should be done.

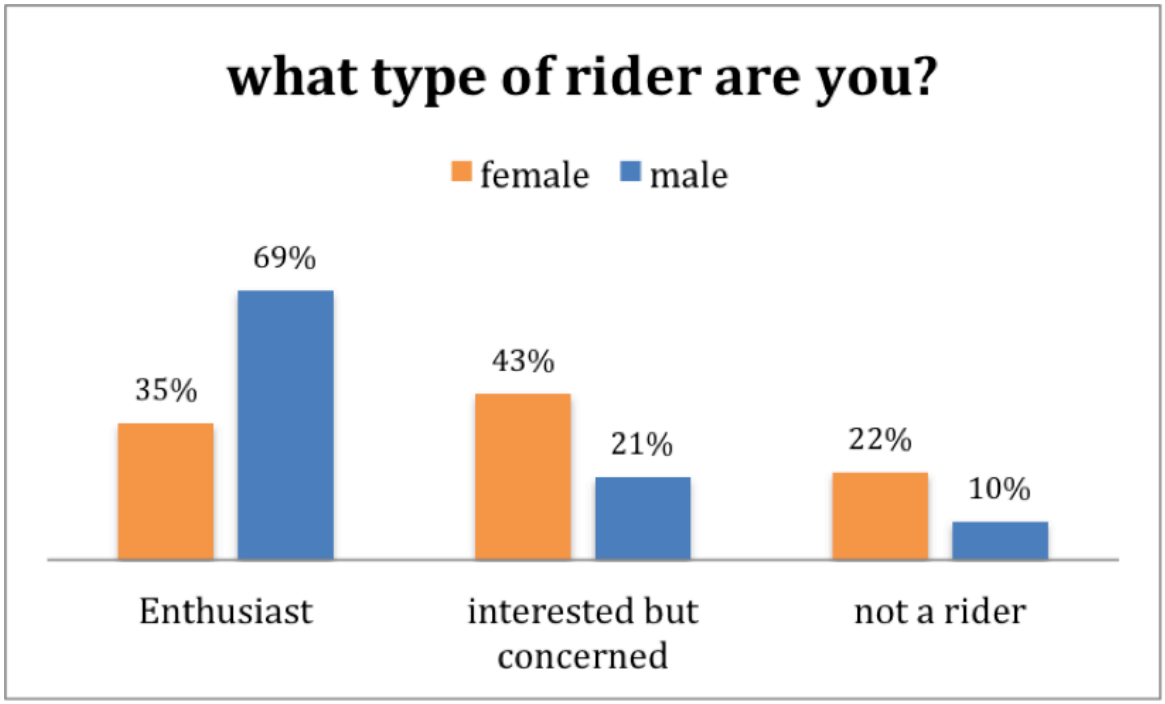

Figure 37. Type of rider by gender

Discussions

CHALLENGES TO CYCLING IN GEORGETOWN

Physical/engineering

Based on our physical barriers survey results, survey respondents reported that the infrastructure and facility-related barriers are the dominant barriers to cycling in Georgetown. Those include lack of dedicated bike lanes, bike parking, straight routes, as well as poor street lighting. Safety problems like bike theft and personal safety at night are important too. There are additional geographic barriers that are more difficult to overcome, such as narrow streets with narrow rights of ways, hilly topography, and hot summer weather.

Regulatory

Many bike-related regulations are missing or too vague in Texas. For example, Texas does not have a statewide law that requires a specific distance for a motor vehicle overtaking a bicycle.

"The overtaking of a bicycle by a motor vehicle is governed by general traffic laws and must be done to the left and at a safe distance." (Tex. Transp. Code Ann. §545.053)

However, several cities such as Austin, San Antonio, New Braunfels, Helotes, El Paso, and Beaumont have passed their own 3-foot safe passing laws. Austin has been using undercover police officers on bicycles to crackdown on violators to enforce the passed safe passing law.

Opportunities for promoting cycling in Georgetown

Special Interest Group

In the analysis, senior citizens are of great interest in Georgetown cycling. This group has its characteristics such as the fact that seniors bike at different times during the day, and they bike for recreation and exercise more than for other purposes. Seniors bike more enthusiastically than any other age groups and bike on streets much more than other groups, which leaves them exposed to certain risks and barriers more than other age groups.

A similar observation can be made with regards to female cyclists (44% of all cyclists), who are much more concerned with and sensitive to topology and street lights than males. As for the youth group (under 17 years of age) that disproportionately participated in our survey, young people may need more encouragement towards bicycling as a means to commute to school.

SW University Students and Staff

Since cycling is the most popular transportation mode among students, having a university in town is one of the common characteristics of places that succeeded in promoting cycling. Southwestern University has its bike share program which has been widely utilized. In our survey, 21.8 percent of the cyclists are somehow affiliated with Southwestern University, and 62.8 percent of those people bike to school or work. Thus, the University is not only the place that generates cyclists but also the influential force behind city-wide cycling.

Relatively Concentrated Point of Interest

In Georgetown, many civic places and places of entertainment are relatively concentrated in the Downtown area. The City Library, County Court House, Tax Office, Theatre, City Hall, Department of Public Safety, George Wagner Middle School and the Southwestern University are all within the 1-1.5 mile area of the town center, which is considered the perfect distance for biking (Pucher & Buehler,2012).

Relatively concentrated point of interest

As previously mentioned, the senior cycling group comprises the majority of cyclists in Georgetown. This is partly due to the Del Webb Sun City Retirement Community located there. One of the benefits of the retirement community in regards to cycling is that while people normally use golf carts to get around in the community, a bicycle is an ideal alternative to a golf cart (Pucher, Buehler,2012). Another benefit noticed during the intercept survey was that of the vibrant social atmosphere. Retired people tend to know each other, and cycling became a social activity among them.

High Participation Rate of Recreational Cycling

The percentage of recreational cyclists and the demand for this kind of activity is very high in Georgetown. This is a great opportunity to promote cycling in general. With the influence of existing cyclists such as senior people, women, students, and young professionals, it would not be difficult to promote cycling citywide.

Suggestions for cycling improvement in Georgetown

Based on the survey feedback and our Environment Audit, even though cycling for recreation and exercise is much more dominant compared to cycling for business, those two purposes for cycling are inter-related. People who bike for a recreational purposes are much more likely to cycling for personal business as well. In a small suburban city like Georgetown, taking advantage of existing cycling culture and resources and promoting cycling in a wider range could be rather beneficial. Nevertheless, since recreational cycling and business commuting are in contrasting stages of development, and cyclists' behavior is varied as well, different strategies should be applied.

There are several improvements needed in order to develop cycling activities in Georgetown.

Non-Recreational Cycling:

Although non-recreational cycling is not the dominant cycling purpose in the city of Georgetown, but it definitely has potential. Opportunities for improvements include:

1. Creating bike connections between neighborhoods and major employers to increase bike-to-work rates.
2. Creating connections to the public transit stations in accordance with the Georgetown Public Transit Plan, to make cycling a connection to transit mode.
3. Developing a complete network to connect such points of interests as the Downtown and University areas, the Sun City internal routes that connect the market, banks and other personal business related places.
4. Building dedicated on- and off-street bike lanes where a cyclist can have the right of way.

5. Building bike facilities along the routes and within surrounding areas of bike destinations, bike parking zones.
6. Establishing supportive traffic regulations, which would protect cyclists' safety and encourage more commute cycling. For instance, Safe Passing laws could require motorized vehicles to keep a certain distance from cyclists and special regulations on speed limit in the cycling peak hours (7-9 a.m. and 4-6 p.m.) during weekdays and weekends.

Recreational Cycling Improvements:

7. Building more hike and bike trails to connect the parks and recreational sites in the city
8. Building facilities along the bike trails such as water fountains and bike-pump stations.
9. Improving street lighting, especially along popular routes including Downtown area and Sun City area, which will provide cyclists with a safer environment to bike, as well as encourage people to cycle after working hours. This especially applies to popular destinations for female cyclists such as shopping centers, Downtown, the Library and places of worship.
10. Organizing city-wide recreational cycling events to have more people involved in cycling. These could be events dedicated only to cycling such as costume cycling parades, bike races, and competitions, etc. Another solution could be integrating cycling into the existing events, for example, the Red Poppy festival in Georgetown. A cycling tour as a part of the festival could be a great opportunity to promote recreational cycling.

General Improvements

1. Cycling safety education is an important means of informing people about the rules and regulations before they get on the road and could improve their level of confidence.
2. Bike Share Program - Expanding the public bike share project by using the existing Southwestern University bike share model. Bike share stations would stimulate people to use cycling for different purposes in different locations. For example, in the Downtown area, a bike share station could encourage people to bike for personal businesses (the tax office, City Hall, etc.) and short leisure trips for food and drinks. Since Georgetown hosts many city-wide events and anticipates an increase of tourism in the city (Comprehensive Plan), a bike share station could provide tourists with easy access to places of interest.
3. Cycling Coaching Program - Engaging experienced cyclists in sharing their experience could help potential new cyclists to identify and avoid some common cycling barriers. Having experienced coaches teaching the techniques of cycling may encourage more local amateurs to participate in recreational cycling and other cycling activities. In Georgetown's case, senior citizens who are passionate about cycling and enthusiastic about social activities could become the best candidates for cycling coaches.
4. A Safe Route to School - In our survey participation, we did not have a clear picture of young people's biking activities, nor did we find accurate data about possible cycling to school, but the potential need is obvious. The City could cooperate with the school district to identify the major routes connecting the neighborhoods and schools. Those steps will help to develop the safe and attractive "bike to school" program.

Conclusions

Highlights of Georgetown study findings

Georgetown is a small suburban city located in Austin metropolitan area in central Texas. Georgetown shares a lot of advantages with other successful small cities in promoting cycling: Small geographic size, relatively calm traffic, popular destinations in a bikeable distance and home to a University campus.

The city of Georgetown has many characteristics that could benefit the future growth of cycling. First, the high participation rate of recreational cycling. While most existing studies are concentrated on cycling for a commute, the prosperity in recreational cycling has been neglected or singled out. When people make bicycle trips, they not necessarily make a separate trip for each purpose. On the contrary, different goals combined in one trip affect each other. In the survey sample, 79.5% participants bike for exercise and for fun. And 92% of participants who bike for work bike for recreational purpose too, but only 13% of the people who bike for recreation bike to work as well. This means there is great potential for inspiring recreational cyclists to do both recreational and work cycling. Of course, this would require a lot of effort. But the thriving recreational culture provides the foundation for a vibrant local bike culture. Second, a great number of cyclists at the age of 55 and older are enthusiastic riders, especially those at 65 and older. This could encourage other age groups to cycle more and will also change people's perception of cycling safety to a certain degree. This senior people's cycling trend is similar to the European one. People at age of 75 and older use bicycle to make 17% of their trips.(European Mission, 2017) It could be due to several reasons: First, Del Webb Sun City retirement community is located in the

northwest part of Georgetown, and the residents use golf cars to get around The bicycle is a great alternative to a golf cart.(Pucher & Buehler, 2012); Second, those senior cyclists are well-educated people. This is consistent with the national data finding that well-educated people are much more likely to bike. Third, culture and life experience background also make a certain impact on cycling activities. During the intercept survey in Georgetown, I ran into a senior cycling club, and interviewees mentioned that they are from Boulder, Colorado, Los Angeles, California where the bicycle culture is thriving. Some of them stated that they used to be tennis coaches. Unfortunately, they cannot play tennis anymore due to injury, so they chose cycling as a physical exercise. Another interviewee's reason for starting to bike was that bicycling became a popular activity among senior people, so he wanted to get involved in their social circle. Senior people's cycling activities could boost cycling citywide and among other age groups. There is one more important advantage of cycling for senior people: this activity could benefit their health condition. University campus in the city can also become a valuable asset in promoting cycling. There is a high percentage of higher-educated cyclists as well as a considerable percentage of "bike to work and school" cyclists rate among the Southwestern University affiliated cyclists. The university not only provides the potential students-cyclists. The popular campus bike sharing program can become a great starting point for expanding this kind of programs citywide.

Besides, it is worth to mention a high bike ownership rate, high propensities of Hispanic or Latino population cycling, especially in "bike to work" in Georgetown. With all that, there are still some underdeveloped areas in Georgetown's cycling program, such as a relatively low participation of young people and children in cycling, and a low rate of cycling for commuting.

Every city has its characteristics in regards to cycling, but places that share the same context could always learn from each other. In Georgetown, the senior people's (55+) passion in cycling is a definite success. Especially since an aging of the population became a trend in a lot of American cities, cycling can become a big part of the social life for senior people. Georgetown could be a great example of how to enrich senior people's social life and improve their health. Besides, programs like the University bike share program is the key to spread the bicycling culture and create a bike-friendly community on campus and outside. The University Bike Share program's experience is valuable not only for university towns; it also provides a good strategy to promote cycling for commuting in districts and neighborhoods. For example, many small communities have established some special areas in the city, such as medical district, central business district, and others. The University Bike Share program could serve as a perfect model for them. Another important thing we learned from studying Georgetown's case is that one should never underestimate the women's passion for cycling and pay more attention to their needs in the process of planning the cycling infrastructure.

LESSONS LEARNED

Small suburban city in Texas could be a great potential place for cycling, the opportunities and advantages are worth the attention. Although the bike-for-commute rate is low, recreational cycling together with the local advantages (home to the college campus) and local policies (increasing of tourism) lead a trend of cycling in a small suburban city.

Also, the sociodemographic characteristics and pattern of cycling could different in a small suburban city than in large cities and on a national level. In Georgetown's case, the cycling pattern in various age groups has its similarities with the national trend but is

at the same time is reversed in some age groups. For example, the 65 and older age group has the highest cycling participation rate in Georgetown while it is the least participating group on a national level. The planning implication of cycling characteristics, the future infrastructures and regulations should serve needs of different users. For example, the senior age group is much more likely to bike in the morning than after sunset, so improving the street lighting would increase the participation.

Aging population could become the leading power of cycling instead of being the less involved group. In Georgetown' case, the senior cyclists are organized, higher-educated people who would devote more time to exercise and to participate in recreational and social activities, which is different in the other studied cases. We also learned that besides exercise and recreational purposes many seniors join the cycling clubs for social connections. Such experienced senior cyclists could become best candidates for leading the local cycling training program.

Females can be as passionate to bike as males; they are just more sensitive to the environment. Judging by the national statistics, one can assume that women are generally less likely to bike. However, according to our survey result, women are just more sensitive to the built environment and more concerned about the safety. If better facilities based on women's perception were available, the number of female cyclists would increase. Thus, when studying the cyclists' characteristics, planners should look at the statistics from different perspectives. Also, cross tabulation and full profile analysis is needed.

NEXT STEP

After studying the characteristics from the data, I started to think of how to make these results useful in the bike planning process. We know that every place has its

complexity and differences between certain social and demographic groups, but why it matters? After I read a journal article about assessing bike facilities based on user experience, I came up with an idea of using this concept before designing in the planning process. I realized that the data characteristics are practical only if there's a pattern for geographic distribution of different user groups. The next step would be exploring how those differences could be considered in the planning process, and how they would influence the public engagement process and infrastructure. For example, it would be beneficial to use diverse strategies for engaging different cyclists group or create different facilities for unique user groups in various areas. Further geographic information analysis will be needed for the next step of the study.

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